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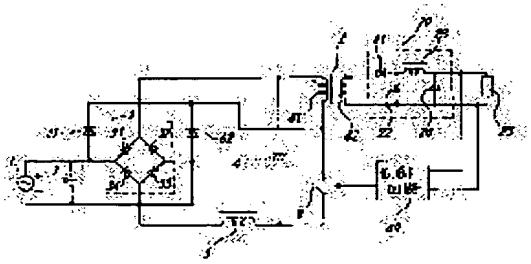
(54) SWITCHING POWER SUPPLY

(57)Abstract:
PURPOSE: To provide a switching power supply that offers favorable power factor, has input characteristics with less input current higher harmonic components, and is further highly efficient.
CONSTITUTION: The positive output terminal of a full-wave rectifying circuit 3, the primary winding 81 of a transformer 8, a switching element 9, a choke coil 5 and the negative output terminal of the full-wave rectifying circuit 3, are connected in series in this order. A smoothing capacitor 4 is connected in parallel with the series circuit composed of the primary winding 81 and the switching element 9. A first diode 61 and a second diode 62 are placed between the respective input terminals of the full-wave rectifying circuit 3 and the connecting point between the primary winding 81 and the switching element 9. A rectifying and smoothing circuit 20 is connected with the secondary winding 82 of the transformer 8. A control circuit 40 is included which controls the on-off ratio of the switching element 9 so that the d.c. output voltage fed to a load 25 will be stabilized. This obtains a switching power supply that offers favorable power factor and has input characteristics with less input current higher harmonic components. In addition this reduces the number of the components placed in



the route of current of t[redacted] choke coil 5 and thus conduction loss.

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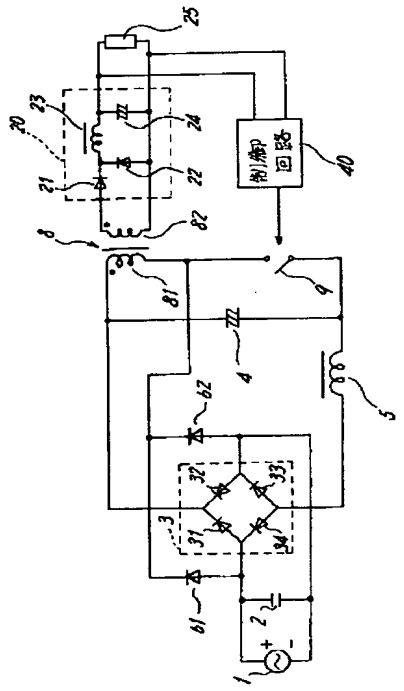
(54)【発明の名称】スイッチング電源装置

(57)【要約】
【目的】　力率が良く、入力電流高調波成分の少ない入力特性を有すると同時に効率の高いスイッチング電源装置を提供することを目的とする。
【構成】　全波整流回路３の正極出力端子、トランス８の一次巻線８１、スイッチ素子９、チョークコイル５、全波整流回路３の負極出力端子をこの順に直列に接続し、一次巻線８１とスイッチ素子９の直列回路に並列に平滑コンデンサ４を接続し、全波整流回路３の入力端子のそれぞれから、一次巻線８１とスイッチ素子９との接続点へ第１，第２のダイオード６１，６２を設け、トランス８の二次巻線８２に整流平滑回路２０を接続し、負荷２５に供給する直流出力電圧を安定化するようにスイッチ素子９のオンオフ比を制御する制御回路４０を設け、力率が良く、入力電流高調波成分の少ない入力特性を有し、チョークコイル５の電流のルートに介在する構成部品を減らし導通損を低減できる。



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【特許請求の範囲】

【請求項１】　入力交流電源を整流する全波整流回路と、一次巻線の一端が前記全波整流回路の正極出力端子に接続されたトランスと、前記トランスの一次巻線の他端に接続されたスイッチ素子と、前記トランスの一次巻線と前記スイッチ素子との直列回路に並列接続された平滑コンデンサと、前記全波整流回路の入力端子のそれぞれにアノード端子が接続され、カソード端子が前記トランスの一次巻線と前記スイッチ素子との接続点に接続された第１，第２のダイオードと、前記スイッチ素子と前記平滑コンデンサとの接続点と前記全波整流回路の負極出力端子との間に接続されたチョークコイルと、前記トランスの二次巻線の出力を整流平滑して直流出力電圧を負荷に供給する整流平滑回路と、前記整流平滑回路の直流出力電圧が安定化するように前記スイッチ素子のオンオフ比を制御する制御回路とを備えたスイッチング電源装置。

【請求項２】　トランスには一次巻線のいずれかの端子に一端が接続された三次巻線を設け、第１，第２のダイオードのカソード端子を、前記三次巻線の他端に接続した請求項１記載のスイッチング電源装置。

【請求項３】　入力交流電源を整流する全波整流回路と、前記全波整流回路の入力端子のそれぞれにアノード端子が接続され、カソード端子が互いに接続された第１，第２のダイオードと、一次巻線と二次巻線を有するトランスと、前記トランスの一次巻線の一端と前記全波整流回路の負極出力端子との間に接続されたスイッチ素子と、一端が前記全波整流回路の正極出力端子に接続され、他端を前記トランスの一次巻線の他端に接続された第１のチョークコイルと、一端が第１，第２のダイオードのカソード端子に接続され、他端を前記トランスの一次巻線とスイッチ素子との接続点に接続され、第１のチョークコイルと電磁結合された第２のチョークコイルと、前記トランスの一次巻線と前記スイッチ素子との直列回路に並列接続された平滑コンデンサと、前記トランスの二次巻線の出力を整流平滑して直流出力電圧を負荷に供給する整流平滑回路と、前記整流平滑回路の直流出力電圧が安定化するように前記スイッチ素子のオンオフ比を制御する制御回路とを備えたスイッチング電源装置。

【請求項４】　トランスには一次巻線のいずれかの端子に一端が接続された三次巻線を設け、第２のチョークコイルの他端を前記トランスの三次巻線の他端に接続した請求項３記載のスイッチング電源装置。

【請求項５】　入力交流電源の両端にそれぞれ一端が接続され、かつ互いに電磁結合した第１，第２のチョークコイルと、一次巻線と二次巻線を有するトランスと、前記トランスの一次巻線の一端に接続されたスイッチ素子と、前記トランスの一次巻線と前記スイッチ素子との直列回路に並列接続された平滑コンデンサと、第１，第２のチョークコイルのそれぞれの他端にアノード端子が接続され、カソード端子が前記トランスの一次巻線と前記スイッチ素子との接続点に接続された第１，第２のダイオードと、第１，第２のチョークコイルのそれぞれの他端にアノード端子が接続され、カソード端子が前記トランスの一次巻線と前記平滑コンデンサとの接続点に接続された第３，第４のダイオードと、入力交流電源の両端にそれぞれカソード端子が接続され、アノード端子が前記スイッチ素子と前記平滑コンデンサとの接続点に接続された第５，第６のダイオードと、前記トランスの二次巻線の出力を整流平滑して直流出力電圧を負荷に供給する整流平滑回路と、前記整流平滑回路の直流出力電圧が安定化するように前記スイッチ素子のオンオフ比を制御する制御回路とを備えたスイッチング電源装置。

【請求項６】　トランスには一次巻線のいずれかの端子に一端が接続された三次巻線を設け、第１，第２のダイオードのカソード端子を、前記三次巻線の他端に接続した請求項５記載のスイッチング電源装置。

【請求項７】　入力交流電源の両端にそれぞれ一端が接続され、かつ互いに電磁結合した第１，第２のチョークコイルと、第１，第２のチョークコイルを介して入力交流電源を整流する全波整流回路と、一端が前記全波整流回路の正極出力端子に接続された一次巻線を有するトランスと、前記トランスの一次巻線の他端と前記全波整流回路の負極出力端子との間に接続されたスイッチ素子と、前記トランスの一次巻線と前記スイッチ素子との直列回路に並列接続された平滑コンデンサと、前記全波整流回路の入力端子のそれぞれにアノード端子が接続され、カソード端子が前記トランスの一次巻線と前記スイッチ素子との接続点に接続された第１，第２のダイオードと、前記トランスの二次巻線の出力を整流平滑し、直流出力電圧を負荷に供給する整流平滑回路と、前記整流平滑回路の直流出力電圧が安定化するように前記スイッチ素子のオンオフ比を制御する制御回路とを備えたスイッチング電源装置。

【請求項８】　トランスには一次巻線のいずれかの端子に一端が接続された三次巻線を設け、第１，第２のダイオードのカソード端子が、前記三次巻線の他端に接続された請求項７記載のスイッチング電源装置。

【請求項９】　入力交流電源を整流する全波整流回路と、前記全波整流回路の正極出力端子に一端が接続された一次巻線を有するトランスと、前記トランスの一次巻線の他端に接続されたスイッチ素子と、前記トランスの一次巻線と前記スイッチ素子との直列回路に並列接続された平滑コンデンサと、前記全波整流回路の入力端子のそれぞれに一端が接続され、他端が共に前記トランスの一次巻線と前記スイッチ素子との接続点に接続された第１，第２のコンデンサと、前記スイッチ素子と前記平滑コンデンサの接続点と前記全波整流回路の負極出力端子との間に介装されたチョークコイルと、前記トランスの

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二次巻線の出力を整流平滑して直流出力電圧を負荷に供給する整流平滑回路と、前記整流平滑回路の直流出力電圧が安定化するように前記スイッチ素子のオンオフ比を制御する制御回路とを備えたスイッチング電源装置。

【請求項１０】　トランスには一次巻線のいずれかの端子に一端を接続された三次巻線を設け、第１のコンデンサと第２のコンデンサとの接続点を前記三次巻線の他端に接続した請求項９記載のスイッチング電源装置。

【請求項１１】　入力交流電源を整流する全波整流回路と、前記全波整流回路の入力端子のそれぞれに一端が接続され、他端が互いに接続された第１，第２のコンデンサと、一次巻線と二次巻線とを有するトランスと、前記トランスの一次巻線の一端と前記全波整流回路の負極出力端子との間に接続されたスイッチ素子と、前記全波整流回路の正極出力端子に一端が接続され、他端を前記トランスの一次巻線の他端に接続した第１のチョークコイルと、第１，第２のコンデンサの接続点に一端が接続され、他端を前記トランスの一次巻線とスイッチ素子との接続点に接続し、かつ第１のチョークコイルと電磁結合された第２のチョークコイルと、前記トランスの一次巻線と前記スイッチ素子との直列回路に並列接続された平滑コンデンサと、前記トランスの二次巻線の出力を整流平滑して直流出力電圧を負荷に供給する整流平滑回路と、前記整流平滑回路の直流出力電圧が安定化するように前記スイッチ素子のオンオフ比を制御する制御回路とを備えたスイッチング電源装置。

【請求項１２】　トランスには一次巻線のいずれかの端子に一端が接続された三次巻線を設け、第２のチョークコイルの他端を前記三次巻線の他端に接続した請求項１１記載のスイッチング電源装置。

【請求項１３】　入力交流電源の両端にそれぞれ一端が接続され、かつ互いに電磁結合した第１，第２のチョークコイルと、一次巻線と二次巻線とを有するトランスと、前記トランスの一次巻線の一端に接続されたスイッチ素子と、前記トランスの一次巻線と前記スイッチ素子との直列回路に並列接続された平滑コンデンサと、第１，第２のチョークコイルのそれぞれの他端に一端が接続され、他端が共に前記トランスの一次巻線と前記スイッチ素子との接続点に接続された第１，第２のコンデンサと、第１，第２のチョークコイルのそれぞれの他端にアノード端子が接続され、カソード端子が前記トランスの一次巻線と前記平滑コンデンサとの接続点に接続された第３，第４のダイオードと、入力交流電源の両端にそれぞれカソード端子が接続され、アノード端子が前記スイッチ素子と前記平滑コンデンサとの接続点に接続された第５，第６のダイオードと、前記トランスの二次巻線の出力を整流平滑して直流出力電圧を負荷に供給する整流平滑回路と、前記整流平滑回路の直流出力電圧が安定化するように前記スイッチ素子のオンオフ比を制御する制御回路とを備えたスイッチング電源装置。

【請求項１４】　トランスには一次巻線のいずれかの端子に一端が接続された三次巻線を設け、第１，第２のコンデンサの接続点を、前記三次巻線の他端に接続した請求項１３記載のスイッチング電源装置。

【請求項１５】　入力交流電源の両端にそれぞれ一端が接続され、かつ互いに電磁結合した第１，第２のチョークコイルと、第１，第２のチョークコイルを介して入力交流電源を整流する全波整流回路と、前記全波整流回路の正極出力端子に一端が接続された一次巻線を有するトランスと、前記トランスの一次巻線の他端と前記全波整流回路の負極出力端子との間に接続されたスイッチ素子と、前記トランスの一次巻線と前記スイッチ素子との直列回路に並列接続された平滑コンデンサと、前記全波整流回路の入力端子のそれぞれに一端が接続され、他端が共に前記トランスの一次巻線と前記スイッチ素子との接続点に接続された第１，第２のコンデンサと、前記トランスの二次巻線の出力を整流平滑して直流出力電圧を負荷に供給する整流平滑回路と、前記整流平滑回路の直流出力電圧が安定化するように前記スイッチ素子のオンオフ比を制御する制御回路とを備えたスイッチング電源装置。

【請求項１６】　トランスには一次巻線のいずれかの端子に一端が接続された三次巻線を設け、第１のコンデンサと第２のコンデンサの接続点を、前記三次巻線の他端に接続した請求項１５記載のスイッチング電源装置。

【請求項１７】　第１，第２のダイオードと直列に、第３のチョークコイルとコンデンサの並列回路を介装した請求項１から請求項８のいずれかに記載のスイッチング電源装置。

【請求項１８】　制御回路は、平滑コンデンサの電圧または平滑コンデンサの電圧に相当する電圧を検出し、検出された電圧を安定化するようにスイッチ素子のスイッチング周波数を変化させるように構成した請求項１から請求項１７のいずれかに記載のスイッチング電源装置。

【請求項１９】　チョークコイルまたは第１，第２のチョークコイルは、流れる電流が大きくなると、そのインダクタンス値が小さくなるような特性を有する請求項１から請求項１８のいずれかに記載のスイッチング電源装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は商用交流電源などの交流を入力とするスイッチング電源装置に関するものである。

【０００２】

【従来の技術】近年、スイッチング電源装置はその高効率な電力変換特性から、各種電子機器の電源回路として多用されている。しかしそれらの多くはコンデンサインプット型の入力整流回路を有しているため、力率が悪く、入力電流に含まれる高調波成分が他の電子機器に障

害を起こすもととなっている。

【０００３】図２９は従来のスイッチング電源装置を示す。図２９において、１は入力交流電源、２は入力フィルタコンデンサで、入力交流電源１の両端に接続される。３は全波整流回路で、ダイオード３１～３４で構成される。４は平滑コンデンサで、全波整流回路３と平滑コンデンサ４とで入力交流電源１の交流入力電圧を整流平滑するコンデンサインプット型の入力整流回路を構成している。８はトランスで、一次巻線８１と二次巻線８２と有する。９はスイッチ素子で、一次巻線８１とスイッチ素子９との直列回路が平滑コンデンサ４の両端に接続される。２０は整流平滑回路で、ダイオード２１，２２，チョークコイル２３とコンデンサ２４とから構成され、スイッチ素子９のオンオフ動作により二次巻線８２に発生する電圧を整流平滑し、負荷２５へ出力直流電圧を供給する。４０は制御回路で、負荷２５へ供給される出力直流電圧を安定化するようにスイッチ素子９のオンオフ比を制御する。

【０００４】このように構成されたスイッチング電源装置の入力波形を図３０に示す。正弦波状の交流入力電圧に対し、そのピーク値付近でのみ全波整流回路３が導通して平滑コンデンサ４への充電電流が集中するため、入力電流波形は導通期間の少ないピーク状になる。

【０００５】

【発明が解決しようとする課題】しかしながら上記の従来の構成では、力率が悪く、その入力電流は多くの高調波成分を含んでおり、他の電子機器に障害を起こすもととなっている。

【０００６】そこで本発明者らは本発明に先立ち、図３１に示すようなスイッチング電源装置を考えた。なお、図２９と同様の作用をするものには同一の符号を付けて説明する。

【０００７】図３１において、１は入力交流電源、２は入力フィルタコンデンサで、入力交流電源１の両端に接続される。３は全波整流回路で、ダイオード３１～３４で構成される。４は平滑コンデンサ、５はチョークコイルで、チョークコイル５の一端は全波整流回路３の正極出力端に接続される。８はトランスで、一次巻線８１、二次巻線８２と、チョークコイル５の他端に接続される三次巻線８３、四次巻線８４とを有する。９はスイッチ素子で、一次巻線８１とスイッチ素子９との直列回路が平滑コンデンサ４の両端に接続される。１０はダイオードで、四次巻線８４との直列回路が平滑コンデンサ４の両端に接続される。２０は整流平滑回路で、ダイオード２１，２２，チョークコイル２３およびコンデンサ２４とから構成され、スイッチ素子９のオンオフ動作により二次巻線８２に発生する電圧を整流平滑し、負荷２５へ出力直流電圧を供給する。４０は制御回路で、負荷２５へ供給される出力直流電圧を安定化するようにスイッチ素子９のオンオフ比を制御する。入力交流電源１の電圧をＶｉ、平滑コンデンサの電圧をＥｃ、一次巻線８１の巻数をＮ１、三次巻線８３の巻数をＮ３、その巻数比をＮ＝（Ｎ３／Ｎ１）四次巻線８４の巻数をＮ４、Ｎ４＝Ｎ１として以下に動作を説明する。

【０００８】まず、入力交流電源１が図３１の極性の期間において、スイッチ素子９がオンの時、三次巻線８３には（Ｎ・Ｅｃ）の電圧が発生する。入力交流電源１の電圧Ｖｉが（１－Ｎ）Ｅｃより大きければ、ダイオード３１，３３が導通し、入力交流電源１→ダイオード３１→チョークコイル５→三次巻線８３→一次巻線８１→スイッチ素子９→ダイオード３３→入力交流電源１、または入力交流電源１→ダイオード３１→チョークコイル５→三次巻線８３→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れる。チョークコイル５にはＶｉ－（１－Ｎ）Ｅｃが印加され、この電流はＶｉ－（１－Ｎ）Ｅｃに比例した傾きで直線的に増加する。

【０００９】スイッチ素子９がオフすると、入力交流電源１→ダイオード３１→チョークコイル５→三次巻線８３→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れる。チョークコイル５にはＶｉ－（１＋Ｎ）Ｅｃが印加され、この電流は直線的に減少し、やがてゼロとなる。

【００１０】入力交流電源１が図３１の極性から反転した場合、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００１１】以上の動作においてＮ＝１の場合の各部動作波形を図３２に示す。図３２において、（ａ）は全波整流回路３の出力電圧波形、（ｂ）はチョークコイル５に流れる電流波形、（ｃ）は入力電流波形である。チョークコイル５に流れる電流は、入力交流電源１の電圧に比例したピーク値を有する鋸波状になる。これがフィルタコンデンサ２で平滑化された入力電流波形は、入力交流電圧に略比例した正弦波状となる。

【００１２】なお、Ｎ＜１の場合、Ｖｉ－（１－Ｎ）Ｅｃ＜０の時に全波整流回路３は導通せず、入力電流波形は図中の破線のようになる。しかしながら、チョークコイル５に流れる電流は三次巻線８３を介して流れるだけでなく、これの誘導電流がスイッチ素子９がオンの時には一次巻線８１に、スイッチ素子９がオフの時には四次巻線８４にも流れるので、導通損が大きく、スイッチング電源装置としての効率が悪いという問題点を有していた。

【００１３】本発明は力率が良く、入力電流高調波成分の少ない入力特性を有すると同時に、さらに効率の高いスイッチング電源装置を提供することを目的とする。

【００１４】

【課題を解決するための手段】請求項１記載のスイッチング電源装置は、入力交流電源を整流する全波整流回路

と、一次巻線の一端が前記全波整流回路の正極出力端子に接続されたトランスと、前記トランスの一次巻線の他端に接続されたスイッチ素子と、前記トランスの一次巻線と前記スイッチ素子との直列回路に並列接続された平滑コンデンサと、前記全波整流回路の入力端子のそれぞれにアノード端子が接続され、カソード端子が前記トランスの一次巻線と前記スイッチ素子との接続点に接続された第１，第２のダイオードと、前記スイッチ素子と前記平滑コンデンサとの接続点と前記全波整流回路の負極出力端子との間に接続されたチョークコイルと、前記トランスの二次巻線の出力を整流平滑して直流出力電圧を負荷に供給する整流平滑回路と、前記整流平滑回路の直流出力電圧が安定化するように前記スイッチ素子のオンオフ比を制御する制御回路とを備えたことを特徴とする。

【００１５】

【作用】この構成によって、チョークコイルに流れる電流のルートは、スイッチ素子がオンの時は、入力交流電源→第１または第２のダイオード→スイッチ素子→チョークコイル→全波整流回路→入力交流電源、スイッチ素子がオフの時は、入力交流電源→全波整流回路→平滑コンデンサ→チョークコイル→全波整流回路→入力交流電源となり、電流のルートにトランスの巻線が介在しない。

【００１６】

【実施例】以下、本発明の実施例を図１～図２８に示す各実施例に基づいて説明する。

（第１の実施例）図１と図２は第１の実施例を示す。

【００１７】図１において、１は入力交流電源、２はフィルタコンデンサで、入力交流電源の両端に接続される。３は全波整流回路で、ダイオード３１～３４で構成され、入力交流電源１の入力交流電圧を整流する。４は平滑コンデンサ、５はチョークコイルで、平滑コンデンサ４とチョークコイル５の直列回路が、全波整流回路３の出力端に接続される。６１は第１のダイオード、６２は第２のダイオードで、第１のダイオード６１と第２のダイオード６２のそれぞれのアノード端子が入力交流電源１に接続され、カソード端子は互いに接続される。８はトランスで、一次巻線８１と二次巻線８２を有する。９はスイッチ素子で、一次巻線８１とスイッチ素子９の直列回路が平滑コンデンサ４の両端に接続される。一次巻線８１とスイッチ素子９の接続点と、第１のダイオード６１と第２のダイオード６２のカソード端子が接続される。２０は整流平滑回路で、ダイオード２１，２２，チョークコイル２３およびコンデンサ２４とで構成される。整流平滑回路２０は二次巻線８２に接続され、スイッチ素子９のオンオフ動作によって二次巻線８２に発生する電圧を整流平滑する。２５は負荷である。４０は制御回路で、負荷２５に供給される直流出力電圧を安定化するようにスイッチ素子９のオンオフ比を制御する。

【００１８】ここで、平滑コンデンサ４，トランス８，スイッチ素子９，整流平滑回路２０，負荷２５および制御回路４０とから構成される部分は、通常のＤＣ／ＤＣコンバータと同様の動作をするので説明は省略する。

【００１９】入力交流電源１が図１の極性の期間において、スイッチ素子９がオンの時、ダイオード６１，３３が導通し、入力交流電源１→ダイオード６１→スイッチ素子９→チョークコイル５→ダイオード３３→入力交流電源１のルートで電流が流れる。チョークコイル５には入力交流電源１の電圧が印加され、この電流は入力交流電源１の電圧に比例した傾きで直線的に増加する。

【００２０】スイッチ素子９がオフすると、ダイオード６１の代わりにダイオード３１が導通し、入力交流電源１→ダイオード３１→平滑コンデンサ４→チョークコイル５→ダイオード３３→入力交流電源１のルートで電流が流れる。チョークコイル５には入力交流電源１と平滑コンデンサ４の電圧の差が印加され、この電流は直線的に減少し、やがてゼロとなる。

【００２１】入力交流電源１が図１の極性から反転した場合、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００２２】このような動作の繰り返しによる各部動作波形を図２に示す。図２において、（ａ）は全波整流回路３の出力電圧波形、（ｂ）はチョークコイル５に流れる電流波形、（ｃ）は入力電流波形である。チョークコイル５に流れる電流は、入力交流電源１の電圧に比例したピーク値を有する鋸波状になる。これがフィルタコンデンサ２で平滑化された入力電流波形は、入力交流電圧にほぼ比例した正弦波状となる。

【００２３】このように第１の実施例では、図３１に示したスイッチング電源装置と同様に入力電流波形を改善して、力率の向上と高調波電流成分の低減が可能になる。さらにチョークコイル５の電流が、図３１に示したトランス８を介さずに流れるので、導通損を低減することができる。

【００２４】（第２の実施例）図３と図４は第２の実施例を示す。図３において、１は入力交流電源、２はフィルタコンデンサ、３は全波整流回路、４は平滑コンデンサ、５はチョークコイル、９はスイッチ素子、２０は整流平滑回路、２５は負荷、４０は制御回路である。以上は図１の構成と同様なものである。

【００２５】図１の構成と異なるのはトランス８に一端を一次巻線８１の一端に接続された三次巻線８３を設け、第１，第２のダイオード６１，６２のカソード端子を三次巻線８３の他端に接続した点である。

【００２６】平滑コンデンサ４の電圧をＥｃ、一次巻線８１の巻数をＮ１、三次巻線８３の巻数をＮ３とし、Ｎ＝（Ｎ３／Ｎ１）として、以下にその動作を説明する。まず、入力交流電源１が図３の極性の期間において、ス

イッチ素子９がオンの時、三次巻線８３にはＮ・Ｅｃの電圧が発生する。入力交流電源１の電圧Ｖｉが（１－Ｎ）Ｅｃより大きければ、ダイオード６１，３３が導通し、入力交流電源１→ダイオード６１→三次巻線８３→一次巻線８１→スイッチ素子９→チョークコイル５→ダイオード３３→入力交流電源１および、入力交流電源１→ダイオード６１→三次巻線８３→平滑コンデンサ４→チョークコイル５→ダイオード３３→入力交流電源１のルートで電流が流れる。チョークコイル５にはＶｉ－（１－Ｎ）Ｅｃが印加され、この電流はＶｉ－（１－Ｎ）Ｅｃに比例した傾きで直線的に増加する。

【００２７】スイッチ素子９がオフすると、ダイオード６１の代わりにダイオード３１が導通し、入力交流電源１→ダイオード３１→平滑コンデンサ４→チョークコイル５→ダイオード３３→入力交流電源１のルートで電流が流れる。チョークコイル５にはＶｉ－Ｅｃが印加され、この電流は直線的に減少し，やがてゼロとなる。

【００２８】入力交流電源１が図３の極性から反転した場合、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００２９】以上の動作においてＮ＝１であれば、第２の実施例の動作は第１の実施例の動作と等価である。Ｎ＜１の場合の各部動作波形を図４に示す。図４において、（ａ）は全波整流回路３の出力電圧波形、（ｂ）はチョークコイル５に流れる電流波形、（ｃ）は入力電流波形である。Ｖｉ－（１－Ｎ）Ｅｃ＜０の時、ダイオード６１は導通せず、入力電流不導通期間が生じ、力率は第１の実施例に比べ若干低下する。しかし、三次巻線８３に発生する電圧は、第１の実施例に比べ小さく、スイッチ素子９がオフの時のダイオード６１への印加電圧が低減される。

【００３０】このように第２の実施例では、図３１に示したスイッチング電源装置と同様に入力電流波形を改善して、力率の向上と高調波電流成分の低減が可能になる。さらにチョークコイル５の電流が、スイッチ素子９がオフの時には三次巻線８３を介さずに流れるので、図３１に示したスイッチング電源装置に比べ導通損を低減することができる。また、Ｎ＜１とすることで、第１の実施例の場合に比べダイオード６１の耐圧を低減することができる。

【００３１】（第３の実施例）図５は第３の実施例を示す。図５において図１の構成と異なるのは、チョークコイル５の構造と接続位置である。この実施例では、図１のチョークコイル５が、第１のチョークコイル５１と第２のチョークコイル５２の２巻線構造に変更されており、第１のチョークコイル５１と第２のチョークコイル５２は互いに電磁結合している。

【００３２】第１のチョークコイル５１は、平滑コンデンサ４と一次巻線８１との接続点と全波整流回路３の正極出力端子と間に接続される。第２のチョークコイル５２は、第１，第２のダイオード６１、６２のカソード端子と、一次巻線８１とスイッチ素子９との接続点の間に接続される。

【００３３】このように構成されたスイッチング電源装置の動作を説明する。まず、入力交流電源１が図５の極性の期間において、スイッチ素子９がオンの時、ダイオード６１，３３が導通し、入力交流電源１→ダイオード６１→第２のチョークコイル５２→スイッチ素子９→ダイオード３３→入力交流電源１のルートで電流が流れる。第２のチョークコイル５２には入力交流電源１の電圧が印加され、この電流は入力交流電源１の電圧に比例した傾きで直線的に増加する。

【００３４】スイッチ素子９がオフすると、ダイオード６１の代わりにダイオード３１が導通し、入力交流電源１→ダイオード３１→第１のチョークコイル５１→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れる。第１のチョークコイル５１には入力交流電源１と平滑コンデンサ４の電圧の差が印加され、この電流は直線的に減少し、やがてゼロとなる。

【００３５】入力交流電源１が図５の極性から反転した場合、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００３６】このような動作の繰り返しにより、第１，第２のチョークコイル５１，５２に流れる電流は、入力交流電源１の電圧に比例したピーク値を有する鋸波状になる。これがフィルタコンデンサ２で平滑化された入力電流波形は、入力交流電圧に略比例した正弦波状となる。

【００３７】このように第３の実施例では、その動作は図１の構成と同様で、入力電流波形を改善して、力率の向上と高調波電流成分の低減が可能になり、図３１に示したスイッチング電源装置に比べ第１，第２のチョークコイル５１，５２の電流が、トランス８を介さずに流れるので導通損を低減することができる。また、チョークコイル５が全波整流回路３の負極側に配置されている図１の構成に比べ、正極側にあるのでスイッチ素子９および制御回路４０が入力交流電源に対して高周波で安定電位となり、誤動作を起こしにくくなる。

【００３８】（第４の実施例）図６は第４の実施例を示す。図６において図５の構成と異なるのは、トランス８の一次巻線８１の一端に接続された三次巻線８３を設け、第２のチョークコイル５２を第１，第２のダイオード６１，６２のカソード端子と、三次巻線８３の他端に接続した点である。

【００３９】平滑コンデンサ４の電圧をＥｃ、一次巻線８１の巻数をＮ１、三次巻線８３の巻数をＮ３とし、Ｎ＝Ｎ３／Ｎ１としてその動作を説明する。まず、入力交流電源１が図６の極性の期間において、スイッチ素子９

がオンの時、三次巻線８３にはＮ・Ｅｃの電圧が発生する。入力交流電源１の電圧Ｖｉが（１－Ｎ）Ｅｃより大きければ、ダイオード６１，３３が導通し、入力交流電源１→ダイオード６１→第２のチョークコイル５２→三次巻線８３→一次巻線８１→スイッチ素子９→ダイオード３３→入力交流電源１および、入力交流電源１→ダイオード６１→第２のチョークコイル５２→三次巻線８３→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れる。第２のチョークコイル５２にはＶｉ－（１－Ｎ）Ｅｃが印加され、この電流はＶｉ－（１－Ｎ）Ｅｃに比例した傾きで直線的に増加する。

【００４０】スイッチ素子９がオフすると、ダイオード６１の代わりにダイオード３１が導通し、入力交流電源１→ダイオード３１→第１のチョークコイル５１→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れる。第１のチョークコイル５１にはＶｉ－Ｅｃが印加され、この電流は直線的に減少し，やがてゼロとなる。

【００４１】入力交流電源１が図６の極性から反転した場合、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００４２】このように、第４の実施例の動作は、Ｎ＝１であれば第１の実施例の動作と等価であり、Ｎ＜１の場合は第２の実施例の動作と等価である。

（第５の実施例）図７は第５の実施例を示す。

【００４３】図７において図５の構成と異なるのは、全波整流回路３を構成する各ダイオード３１～３４と第１，第２のチョークコイル５１，５２と第１，第２のダイオード６１、６２の構造と接続位置である。

【００４４】第１，第２のチョークコイル５１，５２の一端は、それぞれ交流入力電源１の両端に接続される。第１のチョークコイル５１の他端には第１のダイオード６１とダイオード３１のアノード端子が接続され、第２のチョークコイル５２の他端には第２のダイオード６２とダイオード３２のアノード端子が接続される。第１，第２のダイオード６１，６２のカソード端子は、一次巻線８１とスイッチ素子９との接続点に接続される。ダイオード３１，３２のカソード端子は、平滑コンデンサ４と一次巻線８１との接続点に接続される。ダイオード３３，３４のカソード端子はそれぞれ交流入力電源１の両端に接続され、アノード端子はスイッチ素子９と平滑コンデンサ４との接続点に接続される。

【００４５】このように構成されたスイッチング電源装置の動作を説明する。まず、入力交流電源１が図７の極性の期間において、スイッチ素子９がオンの時、ダイオード６１，３３が導通し、入力交流電源１→第１のチョークコイル５１→ダイオード６１→スイッチ素子９→ダイオード３３→入力交流電源１のルートで電流が流れる。第１のチョークコイル５１には入力交流電源１の電圧が印加され、この電流は入力交流電源１の電圧に比例した傾きで直線的に増加する。

【００４６】スイッチ素子９がオフすると、ダイオード６１の代わりにダイオード３１が導通し、入力交流電源１→第１のチョークコイル５１→ダイオード３１→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れる。第１のチョークコイル５１には入力交流電源１と平滑コンデンサ４の電圧の差が印加され、この電流は直線的に減少し、やがてゼロとなる。

【００４７】入力交流電源１が図５の極性から反転した場合、第１のチョークコイル５１の代わりに第２のチョークコイル５２、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００４８】以上のような動作の繰り返しにより、第１，第２のチョークコイル５１，５２に流れる電流は、入力交流電源１の電圧に比例したピーク値を有する鋸波状になる。これがフィルタコンデンサ２で平滑化された入力電流波形は、入力交流電圧に略比例した正弦波状となる。

【００４９】このように第５の実施例では、その動作は図１の構成と同様で、入力電流波形を改善して、力率の向上と高調波電流成分の低減が可能になり、図３１に示したスイッチング電源装置に比べ第１，第２のチョークコイル５１，５２の電流が、トランス８を介さずに流れるので、導通損を低減することができる。

【００５０】また、チョークコイル５が全波整流回路３の負極側に配置されている図１の構成に比べ、正極側にあるのでスイッチ素子９および制御回路４０が入力交流電源に対して高周波で安定電位となり、誤動作を起こしにくくなる点は図５と同様である。

【００５１】（第６の実施例）図８は第６の実施例を示す。図８において図７の構成と異なるのは、トランス８に一端を一次巻線８１の一端に接続された三次巻線８３を設け、第１，第２のダイオード６１，６２のカソード端子を三次巻線８３の他端に接続した点である。

【００５２】平滑コンデンサ４の電圧をＥｃ、一次巻線８１の巻数をＮ１、三次巻線８３の巻数をＮ３とし、Ｎ＝（Ｎ３／Ｎ１）として、その動作を説明する。まず、入力交流電源１が図８の極性の期間において、スイッチ素子９がオンの時、三次巻線８３にはＮ・Ｅｃの電圧が発生する。入力交流電源１の電圧Ｖｉが（１－Ｎ）Ｅｃより大きければ、ダイオード６１および３３が導通し、入力交流電源１→第１のチョークコイル５１→ダイオード６１→三次巻線８３→一次巻線８１→スイッチ素子９→ダイオード３３→入力交流電源１および、入力交流電源１→第１のチョークコイル５１→ダイオード６１→三次巻線８３→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れる。第１のチョークコ

イル５１にはＶｉ－（１－Ｎ）Ｅｃが印加され、この電流はＶｉ－（１－Ｎ）Ｅｃに比例した傾きで直線的に増加する。

【００５３】スイッチ素子９がオフすると、ダイオード６１の代わりにダイオード３１が導通し、入力交流電源１→第１のチョークコイル５１→ダイオード３１→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れる。第１のチョークコイル５１にはＶｉ－Ｅｃが印加され、この電流は直線的に減少し，やがてゼロとなる。

【００５４】入力交流電源１が図８の極性から反転した場合、第１のチョークコイル５１の代わりに第２のチョークコイル５２、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００５５】この第６の実施例の動作は、Ｎ＝１であれば第３の実施例の動作と等価であり、Ｎ＜１の場合は第４の実施例の動作と等価である。

（第７の実施例）図９は第７の実施例を示す。

【００５６】図９において、図５の構成と異なるのは、第１，第２のチョークコイル５１，５２の構造と接続位置である。第１，第２のチョークコイル５１，５２の一端は、それぞれ交流入力電源１の両端に接続される。第１のチョークコイル５１の他端には第１のダイオード６１とダイオード３１のアノード端子が接続され、第２のチョークコイル５２の他端には第２のダイオード６２とダイオード３２のアノード端子が接続される。第１，第２のダイオードのカソード端子は一次巻線８１とスイッチ素子９との接続点に接続される。ダイオード３１，３２のカソード端子は平滑コンデンサ４と一次巻線８１との接続点に接続される。

【００５７】このように構成されたスイッチング電源装置の動作を説明する。まず、入力交流電源１が図９の極性の期間において、スイッチ素子９がオンの時、ダイオード６１，３３が導通し、入力交流電源１→第１のチョークコイル５１→ダイオード６１→スイッチ素子９→ダイオード３３→第２のチョークコイル５２→入力交流電源１のルートで電流が流れる。第１，第２のチョークコイル５１，５２にはそれぞれ入力交流電源１の電圧の（１／２）が印加され、この電流は入力交流電源１の電圧に比例した傾きで直線的に増加する。

【００５８】スイッチ素子９がオフすると、ダイオード６１の代わりにダイオード３１が導通し、入力交流電源１→第１のチョークコイル５１→ダイオード３１→平滑コンデンサ４→ダイオード３３→第２のチョークコイル５２→入力交流電源１のルートで電流が流れる。第１，第２のチョークコイル５１，５２にはそれぞれ入力交流電源１と平滑コンデンサ４の電圧の差の（１／２）が印加され、この電流は直線的に減少し、やがてゼロとなる。

【００５９】入力交流電源１が図９の極性から反転した場合、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００６０】この動作の繰り返しにより、第１，第２のチョークコイル５１，５２に流れる電流は、入力交流電源１の電圧に比例したピーク値を有する鋸波状になる。これがフィルタコンデンサ２で平滑化された入力電流波形は、入力交流電圧に略比例した正弦波状となる。

【００６１】このように第７の実施例の動作は図１の構成と同様で、入力電流波形を改善して、力率の向上と高調波電流成分の低減が可能になり、図３１に示したスイッチング電源装置に比べ第１，第２のチョークコイル５１，５２の電流が、トランス８を介さずに流れるので、導通損を低減することができる。

【００６２】（第８の実施例）図１０は第８の実施例を示す。図１０において、図９の構成と異なるのはトランス８に一端を一次巻線８１の一端に接続された三次巻線８３を設け、第１，第２のダイオード６１，６２のカソード端子を三次巻線８３の他端に接続した点である。平滑コンデンサ４の電圧をＥｃ、一次巻線８１の巻数をＮ１、三次巻線８３の巻数をＮ３とし、Ｎ＝（Ｎ３／Ｎ１）とする。

【００６３】このように構成されたスイッチング電源装置の動作を説明する。まず、入力交流電源１が図１０の極性の期間において、スイッチ素子９がオンの時、三次巻線８３にはＮ・Ｅｃの電圧が発生する。入力交流電源１の電圧Ｖｉが（１－Ｎ）Ｅｃより大きければ、ダイオード６１および３３が導通し、入力交流電源１→第１のチョークコイル５１→ダイオード６１→三次巻線８３→一次巻線８１→スイッチ素子９→ダイオード３３→第２のチョークコイル５２→入力交流電源１および、入力交流電源１→第１のチョークコイル５１→ダイオード６１→三次巻線８３→平滑コンデンサ４→ダイオード３３→第２のチョークコイル５２→入力交流電源１のルートで電流が流れる。第１，第２のチョークコイル５１，５２にはそれぞれ｛Ｖｉ－（１－Ｎ）Ｅｃ｝／２が印加され、この電流はＶｉ－（１－Ｎ）Ｅｃに比例した傾きで直線的に増加する。

【００６４】スイッチ素子９がオフすると、ダイオード６１の代わりにダイオード３１が導通し、入力交流電源１→第１のチョークコイル５１→ダイオード３１→平滑コンデンサ４→ダイオード３３→第２のチョークコイル５２→入力交流電源１のルートで電流が流れる。第１，第２のチョークコイル５１，５２にはそれぞれ（Ｖｉ－Ｅｃ）／２が印加され、この電流は直線的に減少し，やがてゼロとなる。

【００６５】入力交流電源１が図１０の極性から反転した場合、ダイオード６１の代わりにダイオード６２、ダ

イオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。このように第８の実施例の動作は、Ｎ＝１であれば第１の実施例の動作と等価であり、Ｎ＜１の場合は第２の実施例の動作と等価である。

【００６６】（第９の実施例）図１１は第９の実施例を示す。図１１において、図１の構成と異なるのは第１，第２のダイオード６１，６２がそれぞれ第１，第２のコンデンサ７１，７２になっている点である。

【００６７】このように構成されたスイッチング電源装置の動作を説明する。まず、入力交流電源１が図１１の極性の期間において、スイッチ素子９がオンの時、入力交流電源１→コンデンサ７１→スイッチ素子９→チョークコイル５→ダイオード３３→入力交流電源１のルートで電流が流れ増加する。コンデンサ７１の充電が進み、コンデンサ７１と入力交流電源１の接続点の電位が上昇し、平滑コンデンサ４の電位以上になろうとするとダイオード３１が導通し、入力交流電源１→ダイオード３１→平滑コンデンサ４→チョークコイル５→ダイオード３３→入力交流電源１のルートで電流が流れるようになる。

【００６８】スイッチ素子９がオフすると、入力交流電源１→ダイオード３１→平滑コンデンサ４→チョークコイル５→ダイオード３３→入力交流電源１のルートで電流が流れると同時に、トランス８の励磁電流が一次巻線８１→コンデンサ７１→ダイオード３１→一次巻線８１のルートで流れ、コンデンサ７１に蓄えられた電荷を放電させる。

【００６９】入力交流電源１が図１１の極性から反転した場合、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００７０】このような動作の繰り返しによる各部動作波形を図１２に示す。図１２において、（ａ）は全波整流回路３の出力電圧波形、（ｂ）はチョークコイル５に流れる電流波形、（ｃ）は入力電流波形である。チョークコイル５に流れる電流は、入力交流電源１の電圧に追従した連続電流になる。入力電流波形は、これがフィルタコンデンサ２で平滑化されたものである。

【００７１】このように第９の実施例では、入力電流波形を改善して、力率の向上と高調波電流成分の低減が可能になる。さらにチョークコイル５の電流が、図３１に示したトランス８を介さずに流れる上、第１から第８の実施例に比べ振幅の小さな連続電流となるので、導通損を低減することができる。

【００７２】（第１０の実施例）図１３は第１０の実施例を示す。図１３において、図３の構成と異なるのは第１，第２のダイオード６１，６２がそれぞれ第１，第２のコンデンサ７１，７２になっている点である。一次巻線８１の巻数をＮ１、三次巻線８３の巻数をＮ３とし、

Ｎ＝（Ｎ３／Ｎ１）とする。

【００７３】このように第１０の実施例では、Ｎ＝１であればその動作は第９の実施例と等価であり、Ｎ＜１の場合は第１の実施例に対する第２の実施例の効果が、第９の実施例に対しても同様にある。

【００７４】（第１１の実施例）図１４は第１１の実施例を示す。図１４において、図５の構成と異なるのは第１，第２のダイオード６１，６２がそれぞれ第１，第２のコンデンサ７１，７２になっている点である。

【００７５】このように構成されたスイッチング電源装置の動作を説明する。まず、入力交流電源１が図１４の極性の期間において、スイッチ素子９がオンの時、入力交流電源１→コンデンサ７１→第１のチョークコイル５１→スイッチ素子９→ダイオード３３→入力交流電源１のルートで電流が流れ増加する。コンデンサ７１の充電が進み、コンデンサ７１と入力交流電源１の接続点の電位が上昇し、平滑コンデンサ４の電位以上になろうとするとダイオード３１が導通し、入力交流電源１→ダイオード３１→第２のチョークコイル５２→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れるようになる。

【００７６】スイッチ素子９がオフすると、入力交流電源１→ダイオード３１→第２のチョークコイル５２→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れると同時に、トランス８の励磁電流が一次巻線８１→コンデンサ７１→ダイオード３１→一次巻線８１のルートで流れ、コンデンサ７１に蓄えられた電荷を放電させる。

【００７７】入力交流電源１が図１４の極性から反転した場合、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００７８】このように第１１の実施例では、第９の実施例と等価の動作をし、第１の実施例に対する第３の実施例の効果が、第９の実施例に対しても同様にある。

（第１２の実施例）図１５は第１２の実施例を示す。

【００７９】図１５において、図６の構成と異なるのは第１，第２のダイオード６１，６２がそれぞれ第１，第２のコンデンサ７１，７２になっている点である。一次巻線８１の巻数をＮ１、三次巻線８３の巻数をＮ３とし、Ｎ＝（Ｎ３／Ｎ１）とする。

【００８０】このように第１２の実施例では、Ｎ＝１であればその動作は第９の実施例と等価であり、Ｎ＜１の場合は第１の実施例に対する第２の実施例の効果が、第１１の実施例に対しても同様にある。

【００８１】（第１３の実施例）図１６は第１３の実施例を示す。図１６において、図７の構成と異なるのは第１，第２のダイオード６１，６２がそれぞれ第１，第２のコンデンサ７１，７２になっている点である。

【００８２】このように構成されたスイッチング電源装

置の動作を説明する。まず、入力交流電源１が図１６の極性の期間において、スイッチ素子９がオンの時、入力交流電源１→第１のチョークコイル５１→コンデンサ７１→スイッチ素子９→ダイオード３３→入力交流電源１のルートで電流が流れ増加する。コンデンサ７１の充電が進み、コンデンサ７１と第１のチョークコイル５１との接続点の電位が上昇し、平滑コンデンサ４の電位以上になろうとするとダイオード３１が導通し、入力交流電源１→第１のチョークコイル５１→ダイオード３１→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れるようになる。

【００８３】スイッチ素子９がオフすると、入力交流電源１→第１のチョークコイル５１→ダイオード３１→平滑コンデンサ４→ダイオード３３→入力交流電源１のルートで電流が流れると同時に、トランス８の励磁電流が一次巻線８１→コンデンサ７１→ダイオード３１→一次巻線８１のルートで流れ、コンデンサ７１に蓄えられた電荷を放電させる。

【００８４】入力交流電源１が図１６の極性から反転した場合、第１のチョークコイル５１の代わりに第２のチョークコイル５２、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００８５】このように第１３の実施例では第９の実施例と等価の動作をし、第１の実施例に対する第５の実施例の効果が、第９の実施例に対しても同様にある。

（第１４の実施例）図１７は第１４の実施例を示す。

【００８６】図１７において、図８の構成と異なるのは第１，第２のダイオード６１，６２がそれぞれ第１，第２のコンデンサ７１，７２になっている点である。一次巻線８１の巻数をＮ１、三次巻線８３の巻数をＮ３とし、Ｎ＝（Ｎ３／Ｎ１）とすると、Ｎ＝１であればその動作は第９の実施例と等価であり、Ｎ＜１の場合は第１の実施例に対する第２の実施例の効果が、第１３の実施例に対しても同様にある。

【００８７】（第１５の実施例）図１８は本発明の第１５の実施例を示す。図１８において、図９の構成と異なるのは第１，第２のダイオード６１，６２がそれぞれ第１，第２のコンデンサ７１，７２になっている点である。

【００８８】このように構成されたスイッチング電源装置の動作を説明する。まず、入力交流電源１が図１８の極性の期間において、スイッチ素子９がオンの時、入力交流電源１→第１のチョークコイル５１→コンデンサ７１→スイッチ素子９→ダイオード３３→第２のチョークコイル５２→入力交流電源１のルートで電流が流れ増加する。コンデンサ７１の充電が進み、コンデンサ７１と第１のチョークコイル５１の接続点の電位が上昇し、平滑コンデンサ４の電位以上になろうとするとダイオード３１が導通し、入力交流電源１→第１のチョークコイル５１→ダイオード３１→平滑コンデンサ４→ダイオード３３→第２のチョークコイル５２→入力交流電源１のルートで電流が流れるようになる。

【００８９】スイッチ素子９がオフすると、入力交流電源１→第１のチョークコイル５１→ダイオード３１→平滑コンデンサ４→ダイオード３３→第２のチョークコイル５２→入力交流電源１のルートで電流が流れると同時に、トランス８の励磁電流が一次巻線８１→コンデンサ７１→ダイオード３１→一次巻線８１のルートで流れ、コンデンサ７１に蓄えられた電荷を放電させる。

【００９０】入力交流電源１が図１８の極性から反転した場合、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００９１】このように第１５の実施例では、第９の実施例と同様の動作をする。

（第１６の実施例）図１９は第１６の実施例を示す。

【００９２】図１９において、図１０の構成と異なるのは第１，第２のダイオード６１，６２がそれぞれ第１，第２のコンデンサ７１，７２になっている点である。一次巻線８１の巻数をＮ１、三次巻線８３の巻数をＮ３とし、Ｎ＝（Ｎ３／Ｎ１）とすると、Ｎ＝１であればその動作は第９の実施例と等価であり、Ｎ＜１の場合は第１の実施例に対する第２の実施例の効果が、第１５の実施例に対しても同様にある。

【００９３】なお、第２の実施例を示す図３，第４の実施例を示す図６，第６の実施例を示す図８，第８の実施例を示す図１０，第１０の実施例を示す図１３，第１２の実施例を示す図１５，第１４の実施例を示す図１７，第１６の実施例を示す図１９では、三次巻線８３の構成を図２０（ａ）のようにしたが、図２０（ｂ）のような構成も可能であることは言うまでもない。

【００９４】（第１７の実施例）図２１は第１７の実施例を示す。図２１において図１の構成と異なるのは、第１，第２のダイオード６１，６２のカソード端子と一次巻線８１とスイッチ素子９との間に、コンデンサ７３とチョークコイル５３の並列回路が接続されている点である。

【００９５】このように構成されたスイッチング電源装置は、第９の実施例とほぼ同様の動作をする。まず、入力交流電源１が図２１の極性の期間において、スイッチ素子９がオンの時、入力交流電源１→ダイオード６１→コンデンサ７３→スイッチ素子９→チョークコイル５→ダイオード３３→入力交流電源１のルートで電流が流れ増加する。同時にコンデンサ７３と並列接続されたチョークコイル５３が励磁される。スイッチ素子９がオフすると、入力交流電源１→ダイオード３１→平滑コンデンサ４→チョークコイル５→ダイオード３３→入力交流電源１のルートで電流が流れると同時に、チョークコイル

５３の励磁電流がコンデンサ７３に蓄えられた電荷を放電する方向に流れる。

【００９６】入力交流電源１が図２１の極性から反転した場合、ダイオード６１の代わりにダイオード６２、ダイオード３１の代わりにダイオード３２、ダイオード３３の代わりにダイオード３４がそれぞれ動作する。

【００９７】すなわち、第９の実施例における第１，第２のコンデンサ７１，７２の役割をコンデンサ７３が担い、スイッチ素子９がオフの時に、第１，第２のコンデンサ７１，７２の電荷を放電する一次巻線８１の役割をチョークコイル５３が担っているのである。

【００９８】第１７の実施例は、図２２（ａ）に示すように第１，第２のダイオード６１，６２と直列にコンデンサ７３とチョークコイル５３との並列回路を、第１の実施例を示す図１に設けることによって構成したが、同様に図２２（ｂ）に示すように、コンデンサ７４とチョークコイル５４との並列回路を、第１のダイオード６１と直列に、コンデンサ７５とチョークコイル５５との並列回路を第２のダイオード６２と直列に設けることによっても、第１７の実施例と同様の動作をするスイッチング電源装置が得られる。

【００９９】さらにこれらの構成は、上記の第２の実施例から第８の実施例に対しても施し、同様の動作をさせることが可能である。

（第１８の実施例）図２３と図２４は第１８の実施例を示す。

【０１００】図２３において図１の構成と異なるのは、制御回路４０の機能で、平滑コンデンサ４の電圧に応じてスイッチング周波数を制御している点である。スイッチ素子９のオンオフ比を出力直流電圧が安定化するように制御している点は、従来および、上記の各実施例と同様である。

【０１０１】このように構成されたスイッチング電源装置は、第１の実施例とほぼ同様の動作をする。本発明の実施例に用いたフィードフォワードコンバータに代表されるＤＣ／ＤＣコンバータの入出力電圧比は、スイッチ素子９のオンオフ比で表される。このためスイッチング周波数が固定であると、スイッチ素子９のオン時間およびオフ時間は出力電流によってはほとんど変化しない。出力電流が小さくなっても、チョークコイル５あるいは第１，第２のチョークコイル５１，５２を介して入力されるスイッチング１周期当たりのエネルギーはほとんど変化しないのである。したがって、出力電流が小さくなると、入出力電力のバランスが取れるように平滑コンデンサ４の電圧が図２４の特性Ａに示すように上昇し、スイッチ素子９や平滑コンデンサ４に高耐圧のものが必要となる。

【０１０２】これに対して第１８の実施例では、平滑コンデンサ４の電圧を検出し、これが上昇すればスイッチング周波数も上昇するような機能を制御回路４０が有している。出力電流が小さくなり、平滑コンデンサ４の電圧が上昇すると、スイッチング周波数も上昇し、チョークコイル５あるいは第１，第２のチョークコイル５１，５２を介して入力されるスイッチング１周期当たりのエネルギーは減少する。したがって、図２４の特性Ｂに示すように平滑コンデンサ４の電圧の上昇を抑制することができる。

【０１０３】図２５は制御回路４０の具体例を示す回路図である。各端子の符号は図２４の制御回路４０のものと対応させた。図中の破線で囲ったところが本実施例で説明した機能を有する部分である。

【０１０４】図２５において、４００は制御ＩＣで、ここでは型番Ｍ５１９７７を使用する。４０１，４０２は抵抗、４０３はコンデンサで、４０１，４０２がコンデンサ４０３の充放電電流を決定し、その充放電時間が最大オン時間および最小オフ時間となリ、それらの和がスイッチング周期となる。４０４，４０５は抵抗、４０６はシャントレギュレータ、４０７はフォトカプラで、出力直流電圧を検出して制御ＩＣ４００へ帰還する。制御ＩＣ４００は出力直流電圧を安定化するようにオン時間を決定し、スイッチ素子９への駆動パルスを出力する。スイッチング周期からオン時間を差し引いた時間がオフ時間となる。４０８，４０９は抵抗、４１０はシャントレギュレータ、４１１，４１２はダイオード、４１３，４１４は抵抗で、抵抗４０８，４０９で検出した平滑コンデンサ４の電圧をシャントレギュレータ４１０に入力し、平滑コンデンサ４の電圧が所定の電圧以上に上昇すると、ダイオード４１１と抵抗４１３およびダイオード４１２と抵抗４１４を介して電流を流し、コンデンサ４０３の充放電電流を大きくする。すなわちスイッチング周波数が上昇していく。スイッチング周波数が変化しても、制御ＩＣ４００は出力直流電圧を安定化するように、変化した最大オン時間内でオン時間を決定する。

【０１０５】このように第１８の実施例では、平滑コンデンサ４の電圧の上昇を抑制することができるので、スイッチ素子９や平滑コンデンサ４に低耐圧のものが使用できる。

【０１０６】なお、第１８の実施例では、平滑コンデンサ４の電圧を抵抗分割により検出したが、スイッチ素子９がオンのときに発生するトランス８の巻線電圧を検出するなど、平滑コンデンサ４の電圧に相当する電圧を検出してもよいことは言うまでもない。

【０１０７】また、本実施例に示した制御回路４０は第１の実施例に適用したものであるが、第２から第１７の実施例のいずれの実施例にも適用できることは言うまでもない。

【０１０８】（第１９の実施例）図２６と図２７は第１９の実施例を示す。図２６において図１１の構成と異なるのは、流れる電流が大きくなるとチョークコイル５のインダクタンス値が小さくなる図２７に示すような性能

を有している点である。

【０１０９】このように構成されたスイッチング電源装置は、第９の実施例とほぼ同様の動作をする。しかしながら第９の実施例では出力電流が小さくなると、平滑コンデンサ４の電圧が上昇していくのは第１８の実施例で述べた通りである。第９の実施例の場合、スイッチ素子９がオンしている時にチョークコイル５を流れる電流は、チョークコイル５と第１，第２のコンデンサ７１，７２との共振電流で、第１の実施例のように直線的に増加はしない。したがって、出力電流が大きい時には、チョークコイル５のインダクタンス値は小さくても、スイッチング電源装置の動作にはあまり影響しない。一方、出力電流が小さい時には、平滑コンデンサ４の電圧の上昇を抑制するためにも、チョークコイル５のインダクタンス値は大きいほうが好ましい。

【０１１０】これに対して第１９の実施例では、チョークコイル５が電流が大きくなるとインダクタンス値が小さくなる性能を有しているために、出力電流が大きい時には第９の実施例と同様の動作をし、出力電流が小さい時には第９の実施例よりも平滑コンデンサ４の電圧の上昇が抑制される。図２８の特性Ａは第９の実施例の平滑コンデンサ４の電圧の上昇特性、特性Ｂは第１９の実施例の平滑コンデンサ４の電圧の上昇特性を示す。

【０１１１】このような性能を有するチョークコイル５としては、磁気飽和に構わず、巻線の巻数を少なく、磁心のギャップを小さくすればよい。すなわちチョークコイル５は小型化できる。

【０１１２】なお、第１９の実施例と第１８の実施例を併用すれば、スイッチング周波数の変化幅が小さくなり、より効果的であることは言うまでもない。また、本実施例に示したチョークコイル５は、第９の実施例に適用したものであるが、第１０～第１７のいずれの実施例にも適用できることは言うまでもない。チョークコイル５が第１，第２のチョークコイル５１，５２の構成になっている場合は、第１，第２のチョークコイル５１，５２に本実施例で示した性能を有するようにすればよい。

【０１１３】なお、先発明例を示す図３１では平滑コンデンサ４の両端にダイオード１０と四次巻線８４の直列回路を設け、トランス４の磁気リセットを効率的に行うようにしている。しかし、ダイオード１０と四次巻線８４の直列回路の有無が本発明の動作に及ぼす影響は、本発明の効果に対して大きくなく、本発明の説明に必要不可欠なものではなかったので各実施例においては省略した。

【０１１４】また、各実施例において、フィードフォワードコンバータを基本とした回路構成で説明してきたが、その他のＤＣ／ＤＣコンバータを基本としても同様の効果を得ることができる。

【０１１５】

【発明の効果】請求項１の構成によると、チョークコイルの電流がトランスを介さずに流れるので、導通損を低減することができる。したがって、力率が良く、入力電流高調波成分の少ない入力特性を有すると同時に、効率の高い優れたスイッチング電源装置を実現できる。

【０１１６】請求項２の構成によると、チョークコイルの電流が、スイッチ素子がオフの時には三次巻線を介さずに流れるので、導通損を低減することができる。また、一次巻線と三次巻線の巻数比Ｎ＜１とすることで、請求項１の場合に比べダイオードの耐圧を低減することができる。

【０１１７】請求項３の構成によると、第１，第２のチョークコイルの電流がトランスを介さずに流れるので導通損を低減することができる。また、チョークコイル５が全波整流回路の負極側に配置されている請求項１に比べ、正極側にあるのでスイッチ素子および制御回路が入力交流電源に対して高周波で安定電位となり、誤動作を起こしにくくなる。

【０１１８】請求項４の構成によると、Ｎ＝１であれば請求項１と等価であり、Ｎ＜１の場合は第２の実施例の動作と等価である。請求項５の構成によると、第１，第２のチョークコイルの電流がトランスを介さずに流れるので、導通損を低減することができる。また、チョークコイルが全波整流回路の負極側に配置されている請求項１の構成に比べ、正極側にあるのでスイッチ素子および制御回路が入力交流電源に対して高周波で安定電位となり、誤動作を起こしにくくなる。

【０１１９】請求項６の構成によると、Ｎ＝１であれば請求項３と等価であり、Ｎ＜１の場合は請求項４と等価である。請求項７の構成によると、請求項１と同様で、入力電流波形を改善して、力率の向上と高調波電流成分の低減が可能になり、第１，第２のチョークコイルの電流が、トランスを介さずに流れるので、導通損を低減することができる。

【０１２０】請求項８の構成によると、Ｎ＝１であれば請求項１と等価であり、Ｎ＜１の場合は請求項２等価である。請求項９の構成によると、入力電流波形を改善して、力率の向上と高調波電流成分の低減が可能になる。さらにチョークコイルの電流が、トランスを介さずに流れる上、上記の各請求項に比べ振幅の小さな連続電流となるので、導通損を低減することができる。

【０１２１】請求項１０の構成によると、Ｎ＝１であればその動作は請求項９と等価であり、Ｎ＜１の場合は請求項９の場合に比べダイオードの耐圧を低減することができる。

【０１２２】請求項１１の構成によると、請求項９と等価で、しかもチョークコイルが全波整流回路の正極側にあるのでスイッチ素子および制御回路が入力交流電源に対して高周波で安定電位となり、誤動作を起こしにくくなる。

【０１２３】請求項１２の構成によると、Ｎ＝１であれ

ばその動作は請求項９と等価であり、Ｎ＜１の場合は請求項１１の場合に比べダイオードの耐圧を低減することができる。

【０１２４】請求項１３の構成によると、請求項９と等価で、しかもチョークコイルが全波整流回路の負極側に配置されている請求項９の構成に比べ、正極側にあるのでスイッチ素子および制御回路が入力交流電源に対して高周波で安定電位となり、誤動作を起こしにくくなる。

【０１２５】請求項１４の構成によると、Ｎ＝１であればその動作は請求項９と等価であり、Ｎ＜１の場合は請求項１３の場合に比べダイオードの耐圧を低減することができる。

【０１２６】請求項１５の構成によると、請求項９と同様の動作をする。請求項１６の構成によると、請求項９と等価であり、Ｎ＜１の場合は請求項１５の場合に比べダイオードの耐圧を低減することができる。

【０１２７】請求項１７の構成によると、請求項１から請求項８のいずれかにおいて、第１，第２のダイオードと直列に、第３のチョークコイルとコンデンサの並列回路を介装することによって、特性を改善できる。

【０１２８】請求項１８の構成によると、出力電流が小さくなり、平滑コンデンサ４の電圧が上昇すると、制御回路がスイッチング周波数を上昇させて、チョークコイルあるいは第１，第２のチョークコイルを介して入力されるスイッチング１周期当たりのエネルギーは減少し、平滑コンデンサの電圧の上昇を抑制することができ、スイッチ素子や平滑コンデンサに低耐圧のものが使用できる。

【０１２９】請求項１９の構成によると、請求項１から請求項１８のいずれかにおいて、流れる電流が大きくなるとチョークコイルのインダクタンス値が小さくなる性能を有しているので、平滑コンデンサの電圧の上昇が抑制される。

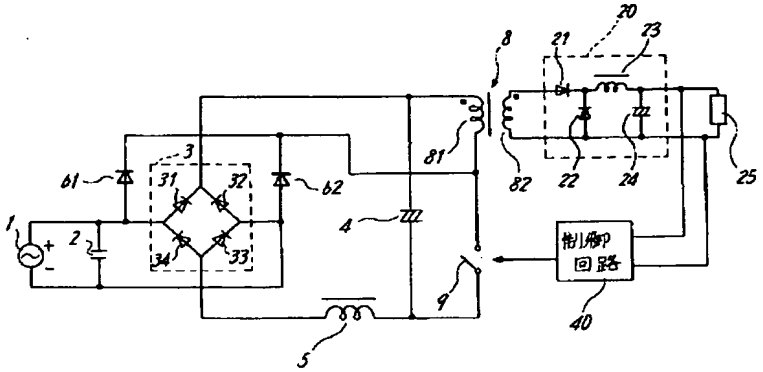
【図面の簡単な説明】

【図１】第１の実施例の構成図
【図２】同実施例の入力波形図
【図３】第２の実施例の構成図
【図４】同実施例の入力波形図
【図５】第３の実施例の構成図
【図６】第４の実施例の構成図
【図７】第５の実施例の構成図
【図８】第６の実施例の構成図
【図９】第７の実施例の構成図
【図１０】第８の実施例の構成図
【図１１】第９の実施例の構成図
【図１２】同実施例の入力波形図
【図１３】第１０の実施例の構成図
【図１４】第１１の実施例の構成図
【図１５】第１２の実施例の構成図
【図１６】第１３の実施例の構成図
【図１７】第１４の実施例の構成図
【図１８】第１５の実施例の構成図
【図１９】第１６の実施例の構成図
【図２０】第２，４，６，８，１０，１２，１４，１６の実施例における要部構成図
【図２１】第１７の実施例の構成図
【図２２】同実施例の要部構成図
【図２３】第１８の実施例の構成図
【図２４】同実施例の要部特性図
【図２５】同実施例の要部回路図
【図２６】第１９の実施例の構成図
【図２７】同実施例のチョークコイルの特性図
【図２８】同実施例の要部特性図
【図２９】従来のスイッチング電源装置の回路構成図
【図３０】従来例の要部特性図
【図３１】発明が解決しようとする課題を説明するスイッチング電源装置の回路構成図
【図３２】同従来例の要部特性図

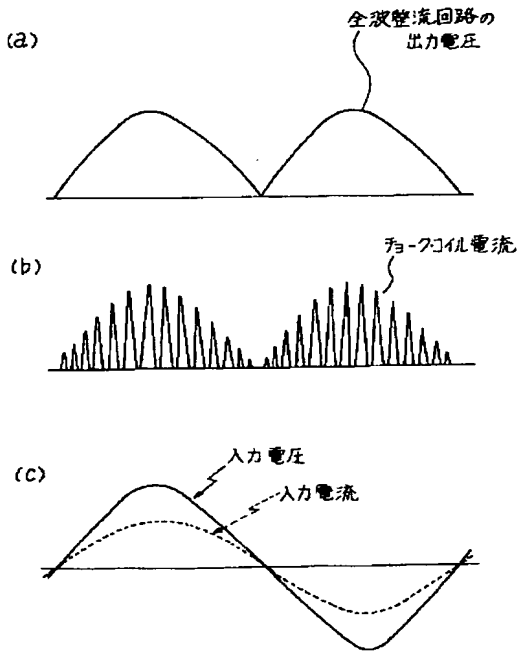
【符号の説明】

1	入力交流電源
3	全波整流回路
３１	第３のダイオード
３２	第４のダイオード
３３	第５のダイオード
３４	第６のダイオード
4	平滑コンデンサ
5	チョークコイル
５１	第１のチョークコイル
５２	第２のチョークコイル
５３	第３のチョークコイル
６１	第１のダイオード
６２	第２のダイオード
７１	第１のコンデンサ
７２	第２のコンデンサ
７３	第３のコンデンサ
8	トランス
８１	トランスの一次巻線
８２	トランスの二次巻線
８３	トランスの三次巻線
9	スイッチ素子
２０	整流平滑回路
２５	負荷
４０	制御回路

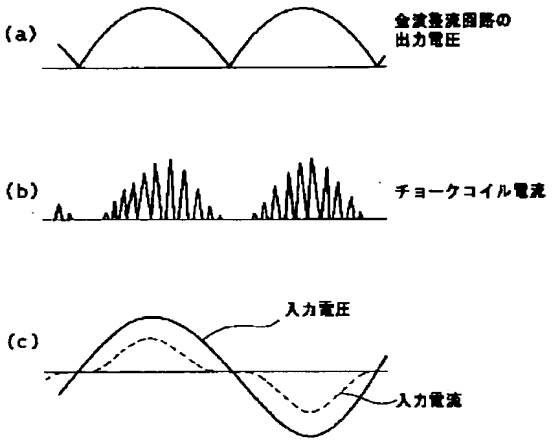
【図１】


制御回路

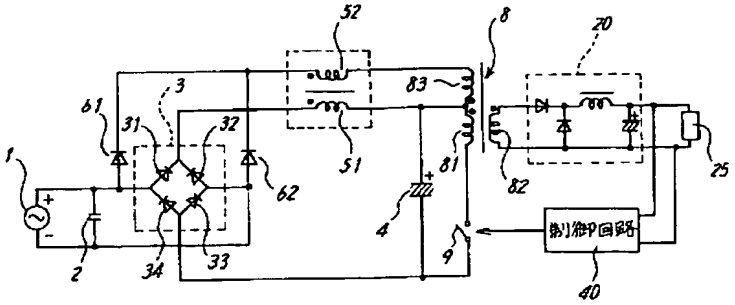
【図２】


(a)
全波整流回路の出力電圧
(b)
チョークコイル電流
(c)
入力電圧
入力電流

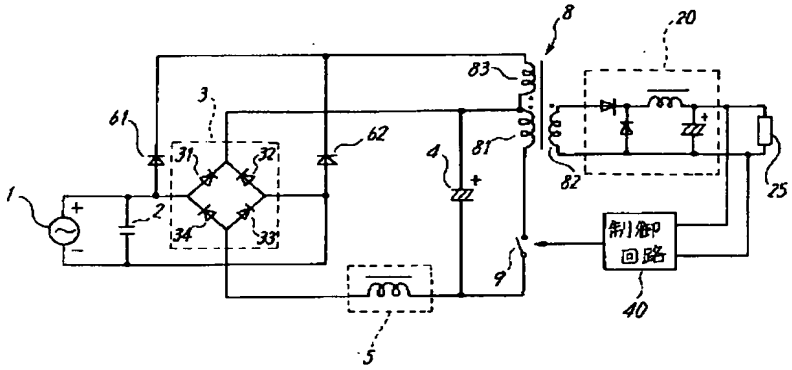
【図４】


(a)
全波整流回路の出力電圧
(b)
チョークコイル電流
(c)
入力電圧
入力電流

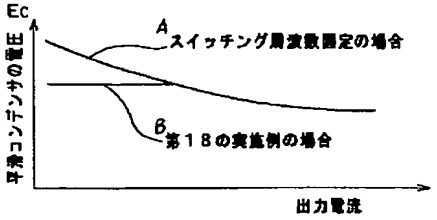
【図６】


制御回路

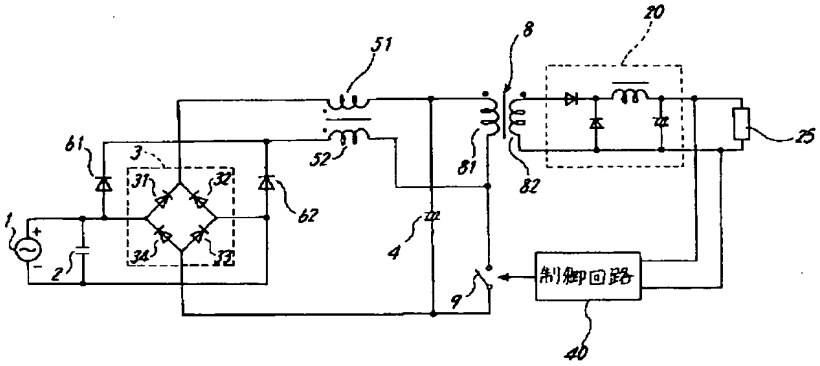
【図３】


制御回路

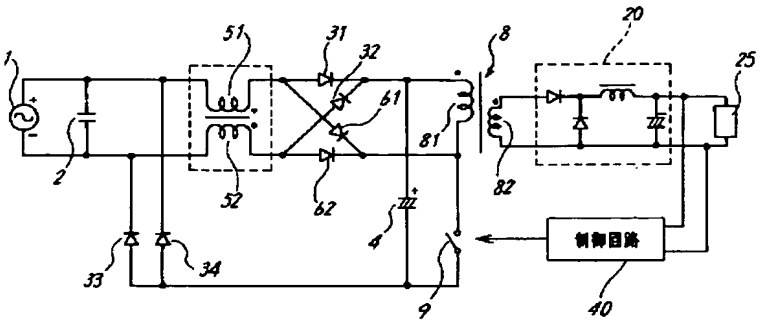
【図２４】


Ec
平滑コンデンサの電圧
A
スイッチング周波数固定の場合
B
第１８の実施例の場合
出力電流

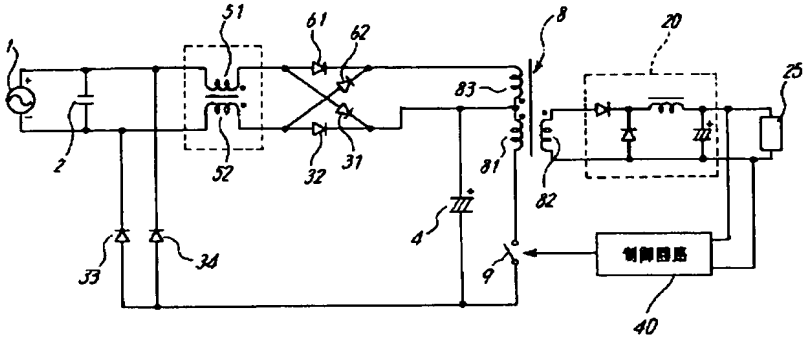
【図５】


制御回路

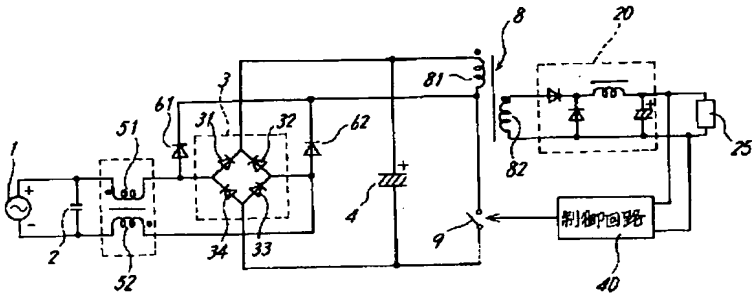
【図７】


制御回路

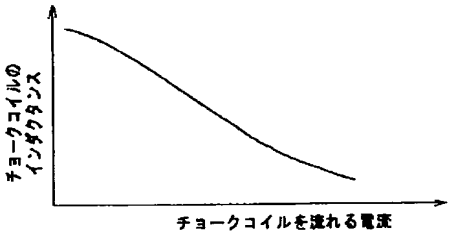
【図８】



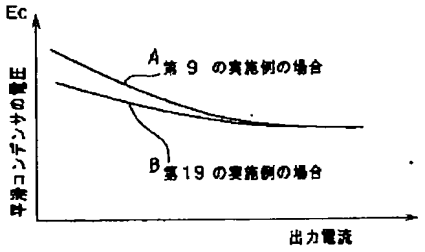
【図９】



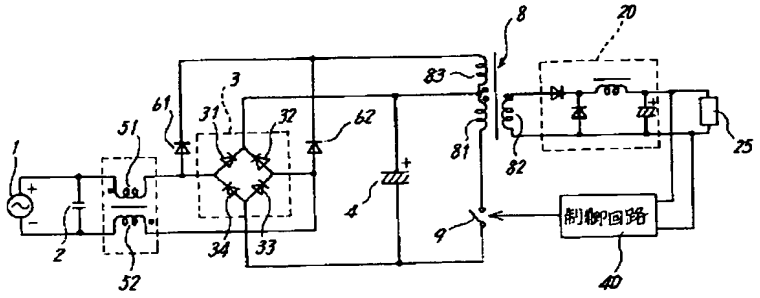
【図２７】



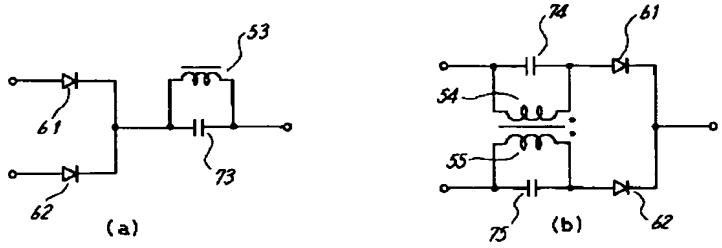
【図２８】



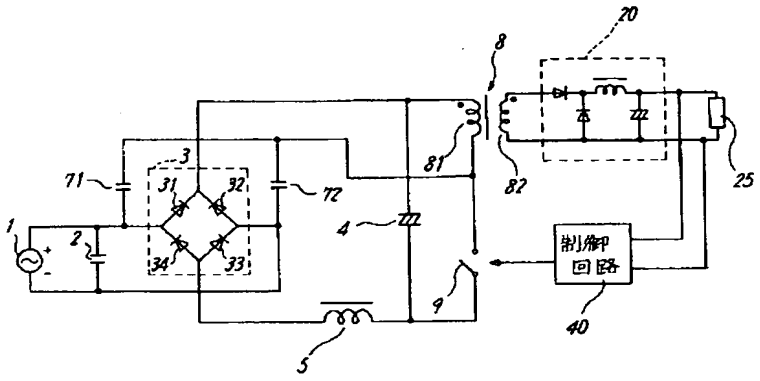
【図１０】



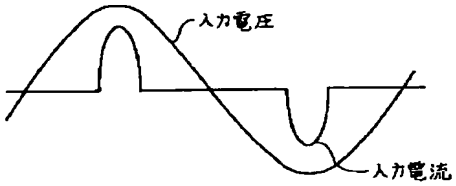
【図２２】



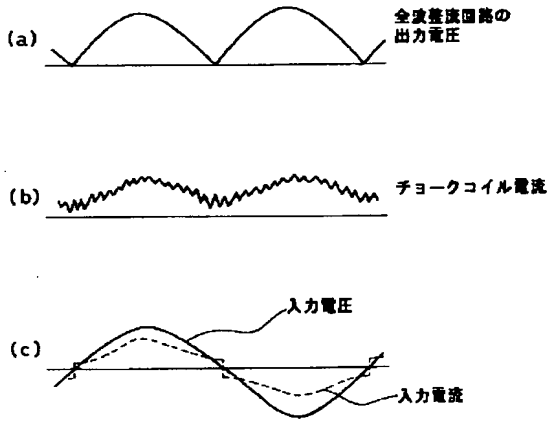
【図１１】



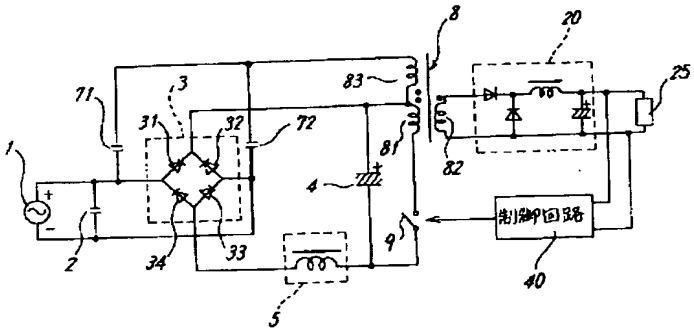
【図３０】



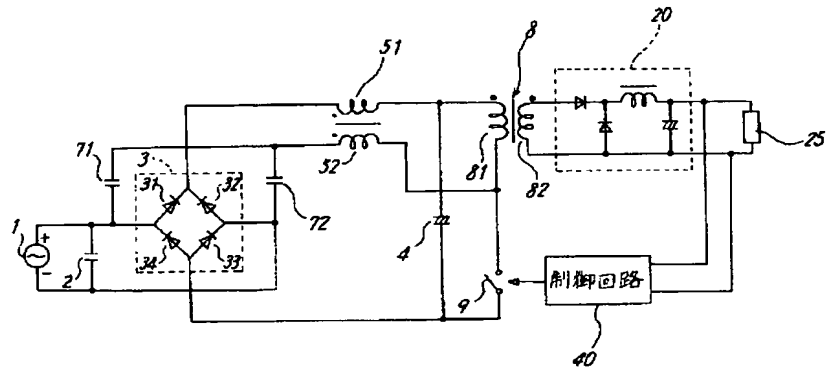
【図１２】



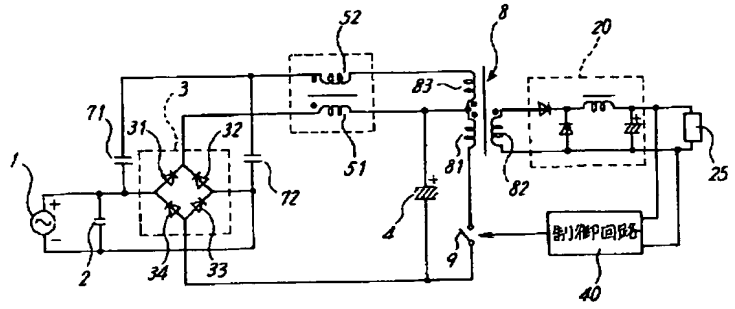
【図１３】



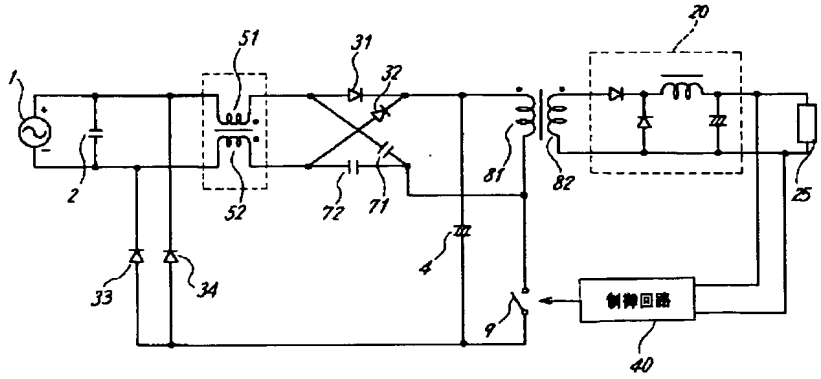
【図１４】



【図１５】


52
8
20
3
83
71
31
32
51
81
82
25
72
4
9
制御回路
1
2
34
33
40

【図１６】


20
51
31
32
1
81
82
25
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52
72
71
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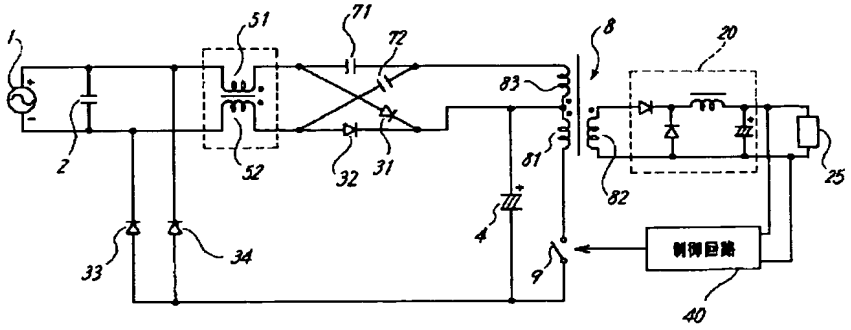
制御回路
9
40

【図１７】


51
71
72
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制御回路
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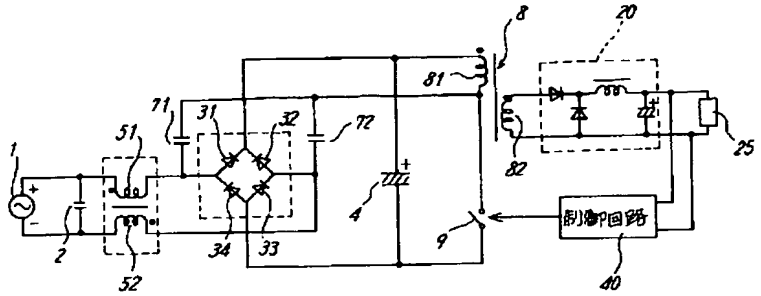
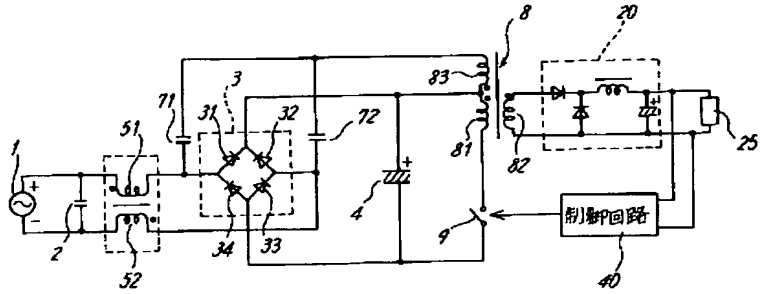
40

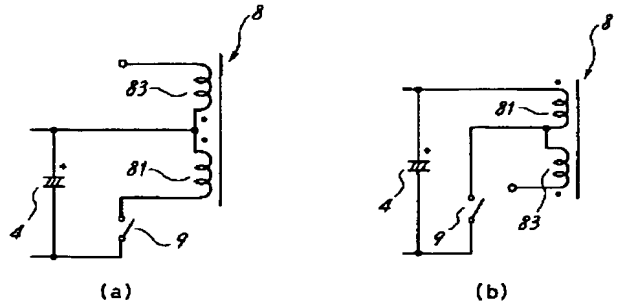
【図１８】



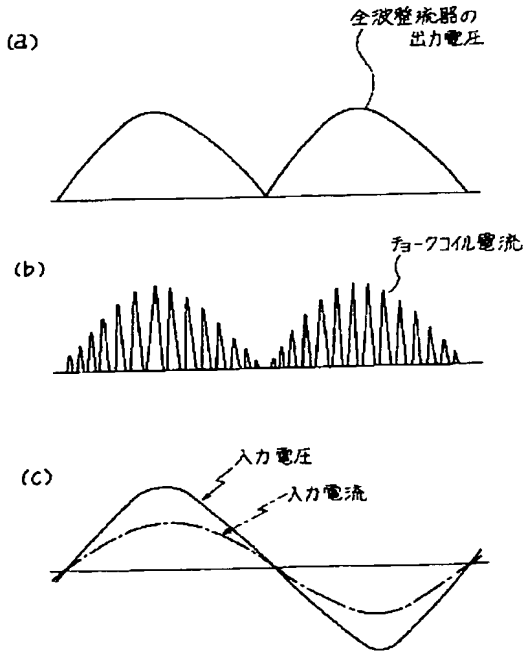
【図１９】



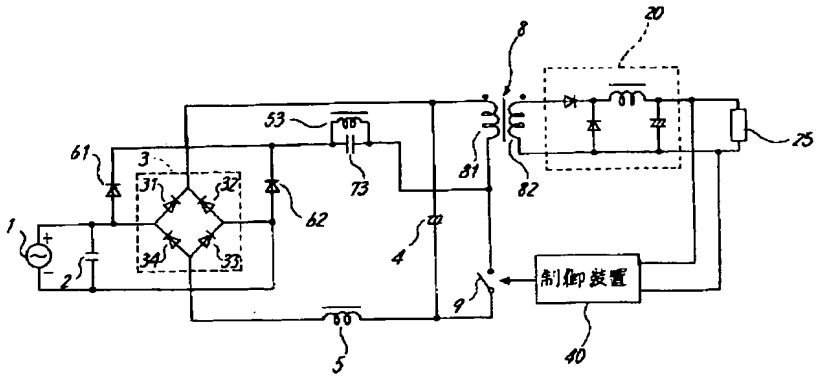
【図２０】



【図３２】



【図２１】



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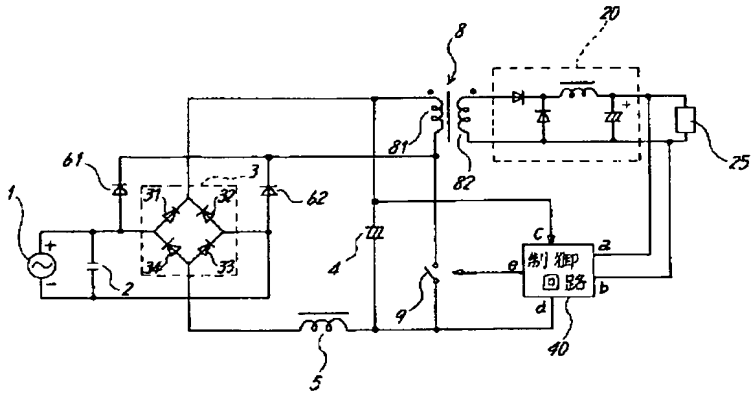

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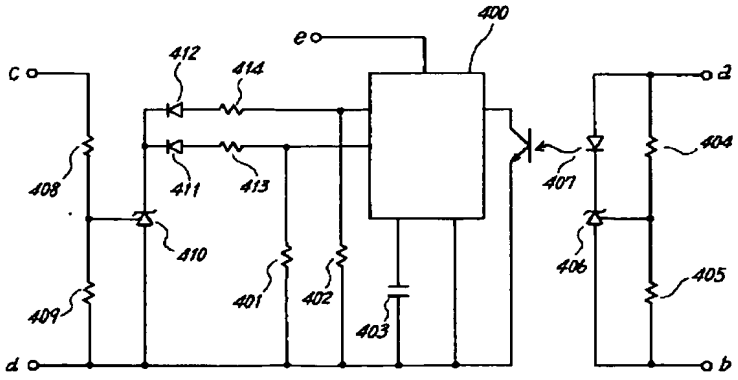

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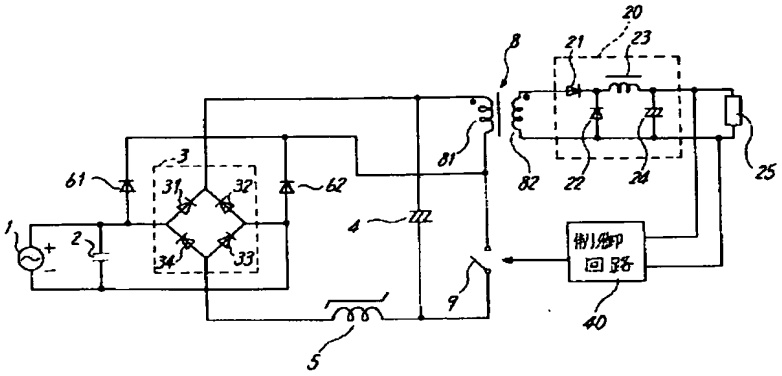

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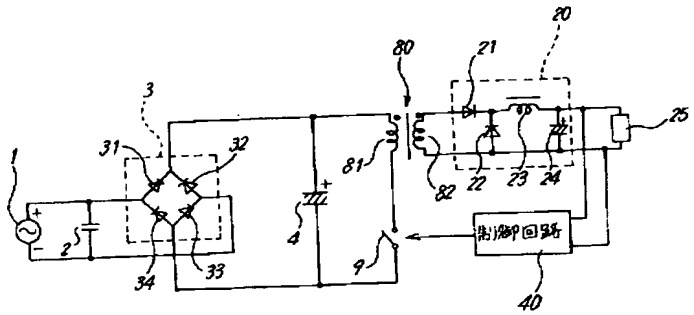
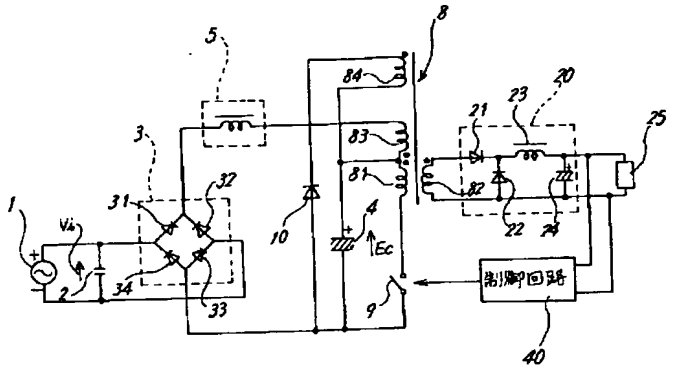


【図３１】



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CLAIMS

[Utility model registration claim]
[Claim 1] Sole structure characterized by having hung on the top face of the rubber bookbinding bottom which constitutes a sole from before ******** at the fingertip section, having made the crevice, having ****(ed) upwards the slippage sheet which becomes this crevice from a polyester sheet etc., and fitting in sponge nature impact absorption plate material.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed explanation of a design]
[0001]
[Industrial Application]
This design is related with a sole, especially the sole structure made of rubber.
[0002]
[Description of the Prior Art]
Many comfortable shoes with which it wears and a feeling is acquired are

marketed without raising the impact absorption function of a sole also not only in the shoes for sports but in casual shoes and giving the fatigue in recent years.

[0003]

When raising the impact absorption function of a sole , much sole structure , such as what made the sole thick on the whole using sponge nature materials , and a thing which fasten the impact absorption plate material of sponge nature in the shape of sandwiches in between with thinner **** (sole) and the insole which used hard-rubber materials , and show a sole in appearance so that it may hardly change to shoes etc. , be propose conventionally .

[0004]

In thinner **** and the insole which used above-mentioned hard-rubber materials, and the sole configuration which fastened the impact absorption plate material of sponge nature in the shape of sandwiches in between, the technique which fits in impact absorption plate material, sticks this at a crevice base or an insole using adhesives in the crevice which hung the conventional thing on the fingertip section from before ********, and was made on the **** top face, and is included in shoes is taken.

[0005]

[Problem(s) to be Solved by the Device]

However, while crookedness is repeated during motion and a walk, the load from a guide peg is repeating a sole, and it produces a migration pressure from a wad non-**** side towards a fingertip section side against this load.

[0006]

Then, when the load from a guide peg is applied in the sole configuration which fastened the impact absorption plate material of sponge nature in the shape of sandwiches between **** and an insole, the underside section of impact absorption plate material is restrained at a **** side, and it will be restrained by the top-face section at an insole side so that it may describe above. The telescopic motion which elasticity impact absorption plate material is pushed towards a ******** side to a fingertip section side with raw ** compared with **** towards a ******** side to a fingertip section side in a migration pressure in this condition, and can be twisted in the direction of a field is produced. It solidifies in fingertip section approach gradually, and an inclination is shown, and the stability which impact absorption plate material causes decreased elasticity gradually, and returns to the original form by repeating this telescopic motion becomes weaker, and it

becomes [it deforms and] the cause of wearing and worsening a feeling. Moreover, an impact absorption function also reduces deformation of impact absorption plate material.

[0007]

This design is made in view of an above-mentioned point, and it aims at continuing at a long period of time, preventing deformation of impact absorption plate material, and offering sole structure with little lowering of an impact absorption function.

[0008]

[Means for Solving the Problem]

The place made into the summary of this design for attaining the above-mentioned object is spent on the top face of the rubber bookbinding bottom which constitutes a sole from before ******** at the fingertip section, makes a crevice, and is in the sole structure characterized by to fit in the sponge nature impact absorption plate material which ****(ed) upwards the slippage sheet which becomes this crevice from a polyester sheet etc., and consists of a sponge rubber plate etc.

[0009]

[Function]

With the migration pressure produced from a ******** side towards a fingertip section side during motion and a walk, the underside of impact absorption plate material Since it slides on a slippage sheet top, and is not restrained to **** and it returns to the original form what repeats the telescopic motion which the underside section and the top-face section of impact absorption plate material can twist in the direction of a field is lost, elastic force cannot be reduced with time, it can continue at a long period of time, deformation of impact absorption plate material can be abolished, and the original form can be maintained, and comfortable -- it wears and a feeling is maintained.

[0010]

[Example]

Hereafter, the example of this design is explained based on a drawing.

[0011]

The top view of **** which drawing 1 shows the example of this design and removed a part of impact absorption plate material, and drawing 2 are the sectional views in the A-A line of drawing 1 .

[0012]

In drawing, 1 shows **** which constitutes a sole. This **** 1 is a rubber sole which consists of harder rubber materials, it is obtained by the usual process, and attaches an upper and a heel by the usual process, and constitutes shoes.

[0013]
2 is the crevice which hung on fingertip section 1b from ********1a of **** 1, and was made on the **** 1 top face, and the base of this crevice 2 is made a flat-surface configuration. Moreover, the depth of a crevice 2 is the thing of abbreviation one half extent of the thickness of **** 1, and, on the whole, is made into the same depth. 3 is the slippage sheet which ****(ed) in the crevice 2, and what cut out the thin sheet (about 0.1mm thing), for example, a polyester sheet, as much as possible carries out suitable [of this slippage sheet 3]. What is the sponge nature impact absorption plate material fitted in in the crevice 2 on the slippage sheet 3, and cut out the sponge rubber plate as this impact absorption plate material 4 carries out suitable [of 4]. Before it fits in the thickness of the impact absorption plate material 4 in a crevice 2 and it attaches an upper, it is the thing of extent to which the top-face section projects on **** 1 slightly.
[0014]
In addition, five in drawing shows the touch-down bottom of **** 1.
[0015]
[Effect of the Device]
Since hung this design that consists of the above-mentioned configuration from before non-**** at the fingertip section on the top face of the rubber bookbinding bottom which constitutes a sole, it made the crevice, ****(ed) the slippage sheet upwards to this crevice and fitted in sponge nature impact absorption plate material, cushioning properties comfortable during motion and a walk are obtained, wear it, and it improves a feeling. With the migration pressure produced from a ******** side towards a fingertip section side under the load repeated to a sole during motion and a walk, moreover, the underside of impact absorption plate material Since it slides on a slippage sheet top and is not restrained to ****, what repeats the telescopic motion which the underside section and top-face section can twist in the direction of a field of impact absorption plate material is lost. impact absorption plate material is opened from a migration pressure, it comes to return to the original form in an instant, elastic force is not reduced with time, and it continues at a long period of time, and impact absorption plate material abolishes deformation, maintains the original form, and is excellent also in the fit nature to a guide peg, and the fatigue is not given -- comfortable -- it wears and a feeling is maintained.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the top view of **** which removed a part of impact absorption plate material which shows the example of this design.
[Drawing 2] It is a sectional view in the A-A line of drawing 1 .
[Description of Notations]
1 -- ****
1a -- ******** side
1b -- Fingertip section
2 -- Crevice
3 -- Slippage sheet
4 -- Impact absorption plate material

[Translation done.]

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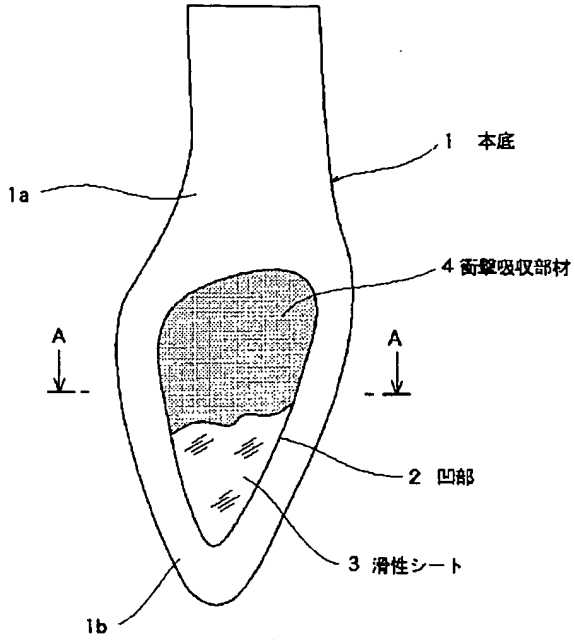
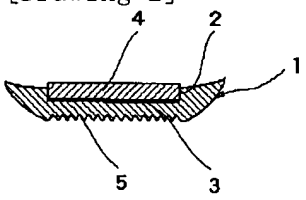
DRAWINGS

[Drawing 1]



[Drawing 2]



[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The full wave rectifier circuit which rectifies input AC power supply, and the transformer by which the end of a primary winding was connected to the positive-electrode output terminal of said full wave rectifier circuit, The smoothing capacitor by which parallel connection was carried out to the series circuit of the switching device connected to the other end of the primary winding of said transformer, and the primary winding of said transformer and said switching device, The 1st and 2nd diode to which the anode terminal was connected to each of the input terminal of said full wave rectifier circuit, and the cathode terminal was connected at the node of the primary winding of said transformer, and said switching device, The choke coil connected between the node of said switching device and said smoothing capacitor, and the negative-electrode output terminal of said full wave rectifier circuit, Switching power supply equipment equipped with the rectification smoothing circuit which carries out rectification smooth [of the output of the secondary winding of said transformer], and supplies direct-current output voltage to a load, and the control circuit which controls the on-off ratio of said switching device so that the direct-current output voltage of said rectification smoothing circuit is stable.
[Claim 2] Switching power supply equipment according to claim 1 which prepared in the transformer the tertiary winding by which the end was connected to one terminal of the primary windings, and connected the cathode terminal of the 1st and 2nd diode to the other end of said tertiary winding.
[Claim 3] The full wave rectifier circuit which rectifies input AC power supply, and the 1st and 2nd diode to which the anode terminal was connected to each of the input terminal of said full wave rectifier circuit, and the cathode terminal of each other was connected, The transformer which has a primary winding and a secondary winding, and the

switching device connected between the end of the primary winding of said transformer, and the negative-electrode output terminal of said full wave rectifier circuit, The 1st choke coil by which the end was connected to the positive-electrode output terminal of said full wave rectifier circuit, and the other end was connected to the other end of the primary winding of said transformer, The 2nd choke coil by which the end was connected to the cathode terminal of the 1st and 2nd diode, the other end was connected at the node of the primary winding of said transformer, and a switching device, and the electromagnetic coupling was carried out to the 1st choke coil, The smoothing capacitor by which parallel connection was carried out to the series circuit of the primary winding of said transformer, and said switching device, Switching power supply equipment equipped with the rectification smoothing circuit which carries out rectification smooth [of the output of the secondary winding of said transformer], and supplies direct-current output voltage to a load, and the control circuit which controls the on-off ratio of said switching device so that the direct-current output voltage of said rectification smoothing circuit is stable.

[Claim 4] Switching power supply equipment according to claim 3 which prepared in the transformer the tertiary winding by which the end was connected to one terminal of the primary windings, and connected the other end of the 2nd choke coil to the other end of the tertiary winding of said transformer.

[Claim 5] The 1st and 2nd choke coil which carried out the electromagnetic coupling, The transformer which has a primary winding and a secondary winding, and the switching device connected to the end of the primary winding of said transformer, The smoothing capacitor by which parallel connection was carried out to the series circuit of the primary winding of said transformer, and said switching device, The 1st and 2nd diode to which the anode terminal was connected to each other end of the 1st and 2nd choke coil, and the cathode terminal was connected at the node of the primary winding of said transformer, and said switching device, The 3rd and 4th diode to which the anode terminal was connected to each other end of the 1st and 2nd choke coil, and the cathode terminal was connected at the node of the primary winding of said transformer, and said smoothing capacitor, The 5th and 6th diode to which the cathode terminal was connected to the both ends of input AC power supply, respectively, and the anode terminal was connected at the node of said switching device and said smoothing capacitor, Switching power supply equipment equipped with the rectification smoothing circuit which carries out rectification smooth [of the output of the secondary

winding of said transformer], and supplies direct-current output voltage to a load, and the control circuit which controls the on-off ratio of said switching device so that the direct-current output voltage of said rectification smoothing circuit is stable.

[Claim 6] Switching power supply equipment according to claim 5 which prepared in the transformer the tertiary winding by which the end was connected to one terminal of the primary windings, and connected the cathode terminal of the 1st and 2nd diode to the other end of said tertiary winding.

[Claim 7] The 1st and 2nd choke coil which carried out the electromagnetic coupling, The full wave rectifier circuit which rectifies input AC power supply through the 1st and 2nd choke coil, The transformer which has the primary winding by which the end was connected to the positive-electrode output terminal of said full wave rectifier circuit, The switching device connected between the other end of the primary winding of said transformer, and the negative-electrode output terminal of said full wave rectifier circuit, The smoothing capacitor by which parallel connection was carried out to the series circuit of the primary winding of said transformer, and said switching device, The 1st and 2nd diode to which the anode terminal was connected to each of the input terminal of said full wave rectifier circuit, and the cathode terminal was connected at the node of the primary winding of said transformer, and said switching device, Switching power supply equipment equipped with the rectification smoothing circuit which carries out rectification smooth [of the output of the secondary winding of said transformer], and supplies direct-current output voltage to a load, and the control circuit which controls the on-off ratio of said switching device so that the direct-current output voltage of said rectification smoothing circuit is stable.

[Claim 8] Switching power supply equipment according to claim 7 which prepares the tertiary winding by which the end was connected to the transformer at one terminal of the primary windings and by which the cathode terminal of the 1st and 2nd diode was connected to the other end of said tertiary winding.

[Claim 9] The full wave rectifier circuit which rectifies input AC power supply, and the transformer which has the primary winding by which the end was connected to the positive-electrode output terminal of said full wave rectifier circuit, The smoothing capacitor by which parallel connection was carried out to the series circuit of the switching device connected to the other end of the primary winding of said transformer, and the primary winding of said transformer and said switching device,

The 1st and 2nd capacitor to which the end was connected to each of the input terminal of said full wave rectifier circuit, and both the other ends were connected at the node of the primary winding of said transformer, and said switching device, The choke coil infixed between said switching devices, nodes of said smoothing capacitor, and negative-electrode output terminals of said full wave rectifier circuit, Switching power supply equipment equipped with the rectification smoothing circuit which carries out rectification smooth [of the output of the secondary winding of said transformer], and supplies direct-current output voltage to a load, and the control circuit which controls the on-off ratio of said switching device so that the direct-current output voltage of said rectification smoothing circuit is stable.

[Claim 10] Switching power supply equipment according to claim 9 which prepared in the transformer the tertiary winding by which the end was connected to one terminal of the primary windings, and connected the node of the 1st capacitor and the 2nd capacitor to the other end of said tertiary winding.

[Claim 11] The full wave rectifier circuit which rectifies input AC power supply, and the 1st and 2nd capacitor to which the end was connected to each of the input terminal of said full wave rectifier circuit, and the other end of each other was connected, The transformer which has a primary winding and a secondary winding, and the switching device connected between the end of the primary winding of said transformer, and the negative-electrode output terminal of said full wave rectifier circuit, The 1st choke coil which the end was connected to the positive-electrode output terminal of said full wave rectifier circuit, and connected the other end to the other end of the primary winding of said transformer, The 2nd choke coil by which the end was connected at the node of the 1st and 2nd capacitor, and connected the other end at the node of the primary winding of said transformer, and a switching device, and the electromagnetic coupling was carried out to the 1st choke coil, The smoothing capacitor by which parallel connection was carried out to the series circuit of the primary winding of said transformer, and said switching device, Switching power supply equipment equipped with the rectification smoothing circuit which carries out rectification smooth [of the output of the secondary winding of said transformer], and supplies direct-current output voltage to a load, and the control circuit which controls the on-off ratio of said switching device so that the direct-current output voltage of said rectification smoothing circuit is stable.

[Claim 12] Switching power supply equipment according to claim 11 which

prepared in the transformer the tertiary winding by which the end was connected to one terminal of the primary windings, and connected the other end of the 2nd choke coil to the other end of said tertiary winding.

[Claim 13] The 1st and 2nd choke coil which carried out the electromagnetic coupling, The transformer which has a primary winding and a secondary winding, and the switching device connected to the end of the primary winding of said transformer, The smoothing capacitor by which parallel connection was carried out to the series circuit of the primary winding of said transformer, and said switching device, The 1st and 2nd capacitor to which the end was connected to each other end of the 1st and 2nd choke coil, and both the other ends were connected at the node of the primary winding of said transformer, and said switching device, The 3rd and 4th diode to which the anode terminal was connected to each other end of the 1st and 2nd choke coil, and the cathode terminal was connected at the node of the primary winding of said transformer, and said smoothing capacitor, The 5th and 6th diode to which the cathode terminal was connected to the both ends of input AC power supply, respectively, and the anode terminal was connected at the node of said switching device and said smoothing capacitor, Switching power supply equipment equipped with the rectification smoothing circuit which carries out rectification smooth [of the output of the secondary winding of said transformer], and supplies direct-current output voltage to a load, and the control circuit which controls the on-off ratio of said switching device so that the direct-current output voltage of said rectification smoothing circuit is stable.

[Claim 14] Switching power supply equipment according to claim 13 which prepared in the transformer the tertiary winding by which the end was connected to one terminal of the primary windings, and connected the node of the 1st and 2nd capacitor to the other end of said tertiary winding.

[Claim 15] The 1st and 2nd choke coil which carried out the electromagnetic coupling, The full wave rectifier circuit which rectifies input AC power supply through the 1st and 2nd choke coil, The transformer which has the primary winding by which the end was connected to the positive-electrode output terminal of said full wave rectifier circuit, The switching device connected between the other end of the primary winding of said transformer, and the negative-electrode output terminal of said full wave rectifier circuit, The smoothing capacitor by which parallel connection was carried out to the series circuit of the primary winding of said transformer, and said switching device, The 1st

and 2nd capacitor to which the end was connected to each of the input terminal of said full wave rectifier circuit, and both the other ends were connected at the node of the primary winding of said transformer, and said switching device, Switching power supply equipment equipped with the rectification smoothing circuit which carries out rectification smooth [of the output of the secondary winding of said transformer], and supplies direct-current output voltage to a load, and the control circuit which controls the on-off ratio of said switching device so that the direct-current output voltage of said rectification smoothing circuit is stable.

[Claim 16] Switching power supply equipment according to claim 15 which prepared in the transformer the tertiary winding by which the end was connected to one terminal of the primary windings, and connected the node of the 1st capacitor and the 2nd capacitor to the other end of said tertiary winding.

[Claim 17] The 1st and 2nd diode and switching power supply equipment given in either of claim 1 to claims 8 which infixed the parallel circuit of the 3rd choke coil and a capacitor in the serial.

[Claim 18] A control circuit is switching power supply equipment given in either of claim 1 to claims 17 constituted so that the electrical potential difference equivalent to the electrical potential difference of a smoothing capacitor or the electrical potential difference of a smoothing capacitor might be detected, the detected electrical potential difference might be stabilized and the switching frequency of a switching device might be changed.

[Claim 19] A choke coil or the 1st and 2nd choke coil is switching power supply equipment given in either of claim 1 to claims 18 which have the property that the inductance value becomes small, when the flowing current becomes large.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the switching power supply equipment which considers the alternating current of a commercial alternating current power source etc. as an input.
[0002]
[Description of the Prior Art] In recent years, switching power supply equipment is used abundantly as a power circuit of various electronic equipment from the efficient power conversion property. However, since those many have the input rectifier circuit of a capacitor input mold, a power-factor is bad and the harmonic content contained in an input current serves as a basis which causes a failure on other electronic equipment.
[0003] Drawing 29 shows conventional switching power supply equipment. In drawing 29 , 1 is input AC power supply, 2 is an input filter capacitor, and it connects with the both ends of input AC power supply 1. 3 is a full wave rectifier circuit and consists of diodes 31-34. 4 is a smoothing capacitor and constitutes the input rectifier circuit of the capacitor input mold which carries out rectification smooth [of the alternating current input voltage of input AC power supply 1] with a full wave rectifier circuit 3 and a smoothing capacitor 4. 8 is a transformer and has with a primary winding 81 and a secondary winding 82. 9 is a switching device and the series circuit of a primary winding 81 and a switching device 9 is connected to the both ends of a smoothing capacitor 4. 20 is a rectification smoothing circuit, it consists of diodes 21 and 22, a choke coil 23, and a capacitor 24, carries out rectification smooth [of the electrical potential difference generated in a secondary winding 82 by the on-off control action of a switching device 9], and supplies output direct current voltage to a load 25. 40 is a control circuit and controls the on-off ratio of a switching device 9 to stabilize the output direct current voltage supplied to a load 25.
[0004] Thus, the input wave of the constituted switching power supply equipment is shown in drawing 30 . In order that a full wave rectifier circuit 3 may flow only near [the] peak value and the charging current to a smoothing capacitor 4 may concentrate to sine wave-like alternating current input voltage, an input current wave form becomes the shape of a peak with few "on" periods.
[0005]

[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional configuration, a power-factor is bad, and the input current contains much harmonic content, and serves as a basis which causes a failure on other electronic equipment.

[0006] Then, this invention persons considered switching power supply equipment as shown in drawing 31 R> 1 in advance of this invention. In addition, the same sign is attached and explained to what carries out the same operation as drawing 29 .

[0007] In drawing 31 , 1 is input AC power supply, 2 is an input filter capacitor, and it connects with the both ends of input AC power supply 1. 3 is a full wave rectifier circuit and consists of diodes 31-34. 4 is a smoothing capacitor, 5 is a choke coil, and the end of a choke coil 5 is connected to the positive-electrode outgoing end of a full wave rectifier circuit 3. 8 is a transformer and has a primary winding 81, a secondary winding 82, and the 83 or fourth tertiary-winding coil 84 connected to the other end of a choke coil 5. 9 is a switching device and the series circuit of a primary winding 81 and a switching device 9 is connected to the both ends of a smoothing capacitor 4. 10 is diode and a series circuit with the fourth coil 84 is connected to the both ends of a smoothing capacitor 4. 20 is a rectification smoothing circuit, it consists of diodes 21 and 22, a choke coil 23, and a capacitor 24, carries out rectification smooth [of the electrical potential difference generated in a secondary winding 82 by the on-off control action of a switching device 9], and supplies output direct current voltage to a load 25. 40 is a control circuit and controls the on-off ratio of a switching device 9 to stabilize the output direct current voltage supplied to a load 25. the electrical potential difference of input AC power supply 1 -- the electrical potential difference of Vi and a smoothing capacitor -- the number of turns of Ec and a primary winding 81 -- N3 is explained for the number of turns of N1 and a tertiary winding 83, and actuation is explained [the turn ratio] for the number of turns of the N= (N3/N1) fourth coil 84 below as N4 and N4=N1.

[0008] First, in the period of the polarity [AC power supply / 1 / input] of drawing 31 , when a switching device 9 is ON, the electrical potential difference of (N-Ec) occurs in a tertiary winding 83. If the electrical potential difference Vi of input AC power supply 1 is larger than Ec (1-N), diodes 31 and 33 will flow and a current will flow by the root of input AC-power-supply 1 -> diode 31 -> choke coil 5 -> tertiary-winding 83 -> primary-winding 81 -> switching device 9 -> diode 33 -> input AC power supply 1 or input AC-power-supply 1 -> diode 31 -> choke coil 5 -> tertiary-winding 83 -> smoothing capacitor 4 -> diode 33 ->

input AC power supply 1. Vi-(1-N) Ec is impressed to a choke coil 5, and this current increases linearly with the inclination proportional to Vi-(1-N) Ec.

[0009] If a switching device 9 turns off, a current will flow by the root of input AC-power-supply 1 -> diode 31 -> choke coil 5 -> tertiary-winding 83 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1. Vi-(1+N) Ec is impressed to a choke coil 5, and this current decreases linearly and serves as zero soon.

[0010] When input AC power supply 1 is reversed from the polarity of drawing 31 , diode 34 operates instead of diode 32 and diode 33 instead of diode 31, respectively.

[0011] In the above actuation, each part actuation wave in N= 1 is shown in drawing 32 . In drawing 32 , the current wave form where (a) flows to the output voltage wave of a full wave rectifier circuit 3, and (b) flows to a choke coil 5, and (c) are input current wave forms. The current which flows to a choke coil 5 becomes the shape of a saw tooth wave which has the peak value proportional to the electrical potential difference of input AC power supply 1. The input current wave form where this was graduated with the filter capacitor 2 serves as the shape of a sine wave which carried out proportionally [abbreviation] at input alternating voltage.

[0012] In addition, in the case of N< 1, it does not flow through a full wave rectifier circuit 3 at the time of Vi-(1-N) Ec<0, but an input current wave form becomes like the broken line in drawing. However, when the induced current of this was [a switching device 9] ON, since it flowed also to the fourth coil 84 when a switching device 9 was OFF, flow loss was large to the primary winding 81, and the current which flows to a choke coil 5 not only flows through a tertiary winding 83, but it had in it the trouble that the effectiveness as switching power supply equipment was bad.

[0013] While the power-factor of this invention is good and it has input characteristics with little input current harmonic content, it aims at offering switching power supply equipment with still higher effectiveness.

[0014]

[Means for Solving the Problem] The full wave rectifier circuit where switching power supply equipment according to claim 1 rectifies input AC power supply, The transformer by which the end of a primary winding was connected to the positive-electrode output terminal of said full wave rectifier circuit, The smoothing capacitor by which parallel connection was carried out to the series circuit of the switching device connected

to the other end of the primary winding of said transformer, and the primary winding of said transformer and said switching device, The 1st and 2nd diode to which the anode terminal was connected to each of the input terminal of said full wave rectifier circuit, and the cathode terminal was connected at the node of the primary winding of said transformer, and said switching device, The choke coil connected between the node of said switching device and said smoothing capacitor, and the negative-electrode output terminal of said full wave rectifier circuit, It is characterized by having the rectification smoothing circuit which carries out rectification smooth [of the output of the secondary winding of said transformer], and supplies direct-current output voltage to a load, and the control circuit which controls the on-off ratio of said switching device so that the direct-current output voltage of said rectification smoothing circuit is stable.

[0015]

[Function] the time of the switching device of the root of the current which flows to a choke coil by this configuration being ON -- input AC-power-supply -> -- when the 1st or the 2nd diode -> switching device -> choke coil -> full-wave-rectifier-circuit -> input AC power supply, and a switching device are OFF, it becomes input AC-power-supply -> full-wave-rectifier-circuit -> smoothing capacitor -> choke coil -> full-wave-rectifier-circuit -> input AC power supply, and is not placed between the roots of a current by the coil of a transformer.

[0016]

[Example] Hereafter, it explains based on each example which shows the example of this invention to drawing 1 - drawing 28 .

(The 1st example) Drawing 1 and drawing 2 show the 1st example.

[0017] In drawing 1 , 1 is input AC power supply, 2 is a filter capacitor, and it connects with the both ends of input AC power supply. 3 is a full wave rectifier circuit, consists of diodes 31-34, and rectifies the input alternating voltage of input AC power supply 1. 4 is a smoothing capacitor, 5 is a choke coil, and the series circuit of a smoothing capacitor 4 and a choke coil 5 is connected to the outgoing end of a full wave rectifier circuit 3. 61 is the 1st diode, 62 is the 2nd diode, each anode terminal of the 1st diode 61 and the 2nd diode 62 is connected to input AC power supply 1, and the cathode terminal of each other is connected. 8 is a transformer and has a primary winding 81 and a secondary winding 82. 9 is a switching device and the series circuit of a switching device 9 is connected with a primary winding 81 to the both ends of a smoothing capacitor 4. The cathode terminal of a primary winding 81, the node of a switching device 9, and the 1st diode

61 and the 2nd diode 62 is connected. 20 is a rectification smoothing circuit and consists of diodes 21 and 22, a choke coil 23, and a capacitor 24. It connects with a secondary winding 82 and the rectification smoothing circuit 20 carries out rectification smooth [of the electrical potential difference generated in a secondary winding 82 by the on-off control action of a switching device 9]. 25 is a load. 40 is a control circuit and controls the on-off ratio of a switching device 9 to stabilize the direct-current output voltage supplied to a load 25.

[0018] Here, since the part which consists of a smoothing capacitor 4, a transformer 8, a switching device 9, a rectification smoothing circuit 20, a load 25, and a control circuit 40 carries out the same actuation as the usual DC to DC converter, explanation is omitted.

[0019] In the period of the polarity [AC power supply / 1 / input] of drawing 1 , when a switching device 9 is ON, diodes 61 and 33 flow and a current flows by the root of input AC-power-supply 1 -> diode 61 -> switching device 9 -> choke coil 5 -> diode 33 -> input AC power supply 1. The electrical potential difference of input AC power supply 1 is impressed to a choke coil 5, and this current increases linearly with the inclination proportional to the electrical potential difference of input AC power supply 1.

[0020] If a switching device 9 turns off, diode 31 will flow instead of being diode 61, and a current will flow by the root of input AC-power-supply 1 -> diode 31 -> smoothing capacitor 4 -> choke coil 5 -> diode 33 -> input AC power supply 1. The difference of the electrical potential difference of input AC power supply 1 and a smoothing capacitor 4 is impressed to a choke coil 5, and this current decreases linearly and serves as zero soon.

[0021] When input AC power supply 1 is reversed from the polarity of drawing 1 , diode 34 operates instead of diode 32 and diode 33 instead of diode 62 and diode 31 instead of diode 61, respectively.

[0022] Each part actuation wave by the repeat of such actuation is shown in drawing 2 . In drawing 2 , the current wave form where (a) flows to the output voltage wave of a full wave rectifier circuit 3, and (b) flows to a choke coil 5, and (c) are input current wave forms. The current which flows to a choke coil 5 becomes the shape of a saw tooth wave which has the peak value proportional to the electrical potential difference of input AC power supply 1. The input current wave form where this was graduated with the filter capacitor 2 serves as the shape of a sine wave mostly proportional to input alternating voltage.

[0023] Thus, in the 1st example, an input current wave form is improved like the switching power supply equipment shown in drawing 31 , and

improvement in a power-factor and reduction of a higher-harmonic current component are attained. Since it flows without furthermore the current of a choke coil 5 minding the transformer 8 shown in drawing 31 , flow loss can be reduced.

[0024] (The 2nd example) Drawing 3 and drawing 4 show the 2nd example. drawing 3 -- setting -- 1 -- input AC power supply and 2 -- a filter capacitor and 3 -- for a choke coil and 9, as for a rectification smoothing circuit and 25, a switching device and 20 are [a full wave rectifier circuit and 4 / a smoothing capacitor and 5 / a load and 40] control circuits. The above is the same as that of the configuration of drawing 1 .

[0025] Differing from the configuration of drawing 1 is the point of having formed the tertiary winding 83 by which the end was connected to the transformer 8 at the end of a primary winding 81, and having connected the cathode terminal of the 1st and 2nd diode 61 and 62 to the other end of a tertiary winding 83.

[0026] The number of turns of N1 and a tertiary winding 83 are set [the electrical potential difference of a smoothing capacitor 4] to N3 for the number of turns of Ec and a primary winding 81, and the actuation is explained below as N= (N3/N1). First, in the period of the polarity [AC power supply / 1 / input] of drawing 3 , when a switching device 9 is ON, the electrical potential difference of N-Ec occurs in a tertiary winding 83. If the electrical potential difference Vi of input AC power supply 1 is larger than Ec (1-N), diodes 61 and 33 will flow and a current will flow by the root of input AC-power-supply 1 -> diode 61 -> tertiary-winding 83 -> primary-winding 81 -> switching device 9 -> choke coil 5 -> diode 33 -> input AC power supply 1 and input AC-power-supply 1 -> diode 61 -> tertiary-winding 83 -> smoothing capacitor 4 -> choke coil 5 -> diode 33 -> input AC power supply 1. Vi-(1-N) Ec is impressed to a choke coil 5, and this current increases linearly with the inclination proportional to Vi-(1-N) Ec.

[0027] If a switching device 9 turns off, diode 31 will flow instead of being diode 61, and a current will flow by the root of input AC-power-supply 1 -> diode 31 -> smoothing capacitor 4 -> choke coil 5 -> diode 33 -> input AC power supply 1. Vi-Ec is impressed to a choke coil 5, and this current decreases linearly and serves as zero soon.

[0028] When input AC power supply 1 is reversed from the polarity of drawing 3 , diode 34 operates instead of diode 32 and diode 33 instead of diode 62 and diode 31 instead of diode 61, respectively.

[0029] If it is N= 1 in the above actuation, actuation of the 2nd example is equivalent to actuation of the 1st example. Each part

actuation wave in N< 1 is shown in drawing 4 . In drawing 4 , the current wave form where (a) flows to the output voltage wave of a full wave rectifier circuit 3, and (b) flows to a choke coil 5, and (c) are input current wave forms. At the time of Vi-(1-N) Ec<0, diode 61 does not flow, but an input current non-"on" period produces it, and a power-factor declines a little compared with the 1st example. However, the electrical potential difference generated in a tertiary winding 83 is small compared with the 1st example, and the applied voltage to the diode 61 in case a switching device 9 is OFF is reduced.

[0030] Thus, in the 2nd example, an input current wave form is improved like the switching power supply equipment shown in drawing 31 , and improvement in a power-factor and reduction of a higher-harmonic current component are attained. Furthermore, since the current of a choke coil 5 flows without minding a tertiary winding 83 when a switching device 9 is OFF, it can reduce flow loss compared with the switching power supply equipment shown in drawing 3131 . Moreover, compared with the case of the 1st example, pressure-proofing of diode 61 can be reduced by being referred to as N< 1.

[0031] (The 3rd example) Drawing 5 shows the 3rd example. In drawing 5 , the structure and the connecting location of a choke coil 5 differ from the configuration of drawing 1 . In this example, the choke coil 5 of drawing 1 is changed into the two-volume lineation of the 1st choke coil 51 and the 2nd choke coil 52, and is carrying out the electromagnetic coupling of the 1st choke coil 51 and 2nd choke coil 52 of each other.

[0032] The 1st choke coil 51 is connected with the node of a smoothing capacitor 4 and a primary winding 81, and the positive-electrode output terminal of a full wave rectifier circuit 3 in between. The 2nd choke coil 52 is connected between the nodes of the cathode terminal of the 1st and 2nd diode 61 and 62, and a primary winding 81 and a switching device 9.

[0033] Thus, actuation of the constituted switching power supply equipment is explained. first, the time of a switching device 9 being ON in the period of the polarity [AC power supply / 1 / input] of drawing 5 -- diodes 61 and 33 -- flowing -- input AC-power-supply 1 -> diode 61-> -- a current flows by the root of 2nd choke coil 52 -> switching device 9 -> diode 33 -> input AC power supply 1. The electrical potential difference of input AC power supply 1 is impressed to the 2nd choke coil 52, and this current increases linearly with the inclination proportional to the electrical potential difference of input AC power supply 1.

[0034] instead of being diode 61 when a switching device 9 turns off --

diode 31 -- flowing -- input AC-power-supply 1 -> diode 31-> -- a current flows by the root of 1st choke coil 51 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1. The difference of the electrical potential difference of input AC power supply 1 and a smoothing capacitor 4 is impressed to the 1st choke coil 51, and this current decreases linearly and serves as zero soon.

[0035] When input AC power supply 1 is reversed from the polarity of drawing 5 , diode 34 operates instead of diode 32 and diode 33 instead of diode 62 and diode 31 instead of diode 61, respectively.

[0036] By the repeat of such actuation, the current which flows to the 1st and 2nd choke coil 51 and 52 becomes the shape of a saw tooth wave which has the peak value proportional to the electrical potential difference of input AC power supply 1. The input current wave form where this was graduated with the filter capacitor 2 serves as the shape of a sine wave which carried out proportionally [abbreviation] at input alternating voltage.

[0037] Thus, in the 3rd example, the actuation is the same as the configuration of drawing 1 , improve an input current wave form and improvement in a power-factor and reduction of a higher-harmonic-wave current component are attained, and since it flows without the current of the 1st and 2nd choke coil 51 and 52 minding a transformer 8 compared with the switching power supply equipment shown in drawing 31 , flow loss can be reduced. Moreover, since a choke coil 5 is in a positive-electrode side compared with the configuration of drawing 1 R> 1 arranged at the negative-electrode side of a full wave rectifier circuit 3, a switching device 9 and a control circuit 40 serve as stabilization potential by the RF to input AC power supply, and it lifting-comes to be hard of malfunction.

[0038] (The 4th example) Drawing 6 shows the 4th example. Differing from the configuration of drawing 5 in drawing 6 is the point of having formed the tertiary winding 83 connected to the end of the primary winding 81 of a transformer 8, and having connected the 2nd choke coil 52 to the cathode terminal of the 1st and 2nd diode 61 and 62, and the other end of a tertiary winding 83.

[0039] The number of turns of N1 and a tertiary winding 83 are set [the electrical potential difference of a smoothing capacitor 4] to N3 for the number of turns of Ec and a primary winding 81, and the actuation is explained as N=N3/N1. First, in the period of the polarity [AC power supply / 1 / input] of drawing 6 , when a switching device 9 is ON, the electrical potential difference of N-Ec occurs in a tertiary winding 83. if the electrical potential difference Vi of input AC power supply 1 is

larger than Ec (1-N) -- diodes 61 and 33 -- flowing -- input AC-power-supply 1 -> diode 61-> -- 2nd choke coil 52 -> tertiary-winding 83 -> primary-winding 81 -> switching device 9 -> diode 33 -> input AC-power-supply 1 and input AC-power-supply 1 -> diode 61-> -- a current flows by the 2nd root of choke coil 52 -> tertiary-winding 83 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1. Vi-(1-N) Ec is impressed to the 2nd choke coil 52, and this current increases linearly with the inclination proportional to Vi-(1-N) Ec.

[0040] instead of being diode 61 when a switching device 9 turns off -- diode 31 -- flowing -- input AC-power-supply 1 -> diode 31-> -- a current flows by the root of 1st choke coil 51 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1. Vi-Ec is impressed to the 1st choke coil 51, and this current decreases linearly and serves as zero soon.

[0041] When input AC power supply 1 is reversed from the polarity of drawing 6 , diode 34 operates instead of diode 32 and diode 33 instead of diode 62 and diode 31 instead of diode 61, respectively.

[0042] Thus, if actuation of the 4th example is N= 1, it is equivalent to actuation of the 1st example, and, ** Li and in the case of N< 1, equivalent to actuation of the 2nd example.

(The 5th example) Drawing 7 shows the 5th example.

[0043] In drawing 7 , the structure and the connecting location of each diodes 31-34, the 1st and 2nd choke coil 51 and 52, and the 1st and 2nd diode 61 and 62 which constitute a full wave rectifier circuit 3 differ from the configuration of drawing 5 .

[0044] The end of the 1st and 2nd choke coil 51 and 52 is connected to the both ends of the alternating current input power 1, respectively. The anode terminal of the 1st diode 61 and diode 31 is connected to the other end of the 1st choke coil 51, and the anode terminal of the 2nd diode 62 and diode 32 is connected to the other end of the 2nd choke coil 52. The cathode terminal of the 1st and 2nd diode 61 and 62 is connected at the node of a primary winding 81 and a switching device 9. The cathode terminal of diodes 31 and 32 is connected at the node of a smoothing capacitor 4 and a primary winding 81. The cathode terminal of diodes 33 and 34 is connected to the both ends of the alternating current input power 1, respectively, and an anode terminal is connected at the node of a switching device 9 and a smoothing capacitor 4.

[0045] Thus, actuation of the constituted switching power supply equipment is explained. first, the time of a switching device 9 being ON in the period of the polarity [AC power supply / 1 / input] of drawing 7 -- diodes 61 and 33 -- flowing -- input AC-power-supply 1-> -- a

current flows by the 1st root of choke coil 51 -> diode 61 -> switching device 9 -> diode 33 -> input AC power supply 1. The electrical potential difference of input AC power supply 1 is impressed to the 1st choke coil 51, and this current increases linearly with the inclination proportional to the electrical potential difference of input AC power supply 1.

[0046] instead of being diode 61 when a switching device 9 turns off -- diode 31 -- flowing -- input AC-power-supply 1-> -- a current flows by the 1st root of choke coil 51 -> diode 31 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1. The difference of the electrical potential difference of input AC power supply 1 and a smoothing capacitor 4 is impressed to the 1st choke coil 51, and this current decreases linearly and serves as zero soon.

[0047] When input AC power supply 1 is reversed from the polarity of drawing 5 , diode 34 operates instead of the 2nd choke coil 52 and diode 61 instead of the 1st choke coil 51, and operates instead of diode 32 and diode 33 instead of diode 62 and diode 31, respectively.

[0048] By the repeat of the above actuation, the current which flows to the 1st and 2nd choke coil 51 and 52 becomes the shape of a saw tooth wave which has the peak value proportional to the electrical potential difference of input AC power supply 1. The input current wave form where this was graduated with the filter capacitor 2 serves as the shape of a sine wave which carried out proportionally [abbreviation] at input alternating voltage.

[0049] Thus, in the 5th example, the actuation is the same as the configuration of drawing 1 , improve an input current wave form and improvement in a power-factor and reduction of a higher-harmonic-wave current component are attained, and since it flows without the current of the 1st and 2nd choke coil 51 and 52 minding a transformer 8 compared with the switching power supply equipment shown in drawing 31 , flow loss can be reduced.

[0050] Moreover, the point of lifting-coming to be hard of malfunction by a switching device 9 and a control circuit 40 serving as stabilization potential by the RF to input AC power supply since a choke coil 5 is in a positive-electrode side compared with the configuration of drawing 1 arranged at the negative-electrode side of a full wave rectifier circuit 3 is the same as that of drawing 5 .

[0051] (The 6th example) Drawing 8 shows the 6th example. Differing from the configuration of drawing 7 in drawing 8 is the point of having formed the tertiary winding 83 by which the end was connected to the transformer 8 at the end of a primary winding 81, and having connected

the cathode terminal of the 1st and 2nd diode 61 and 62 to the other end of a tertiary winding 83.

[0052] The number of turns of N1 and a tertiary winding 83 are set [the electrical potential difference of a smoothing capacitor 4] to N3 for the number of turns of Ec and a primary winding 81, and the actuation is explained as N= (N3/N1). First, in the period of the polarity [AC power supply / 1 / input] of drawing 8 , when a switching device 9 is ON, the electrical potential difference of N-Ec occurs in a tertiary winding 83. if the electrical potential difference Vi of input AC power supply 1 is larger than Ec (1-N) -- diodes 61 and 33 -- flowing -- input AC-power-supply 1-> -- the 1st choke coil 51 -> diode 61 -> tertiary-winding 83 -> primary-winding 81 -> switching device 9 -> diode 33 -> input AC power supply 1 and input AC-power-supply 1-> -- a current flows by the 1st root of choke coil 51 -> diode 61 -> tertiary-winding 83 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1. Vi-(1-N) Ec is impressed to the 1st choke coil 51, and this current increases linearly with the inclination proportional to Vi-(1-N) Ec.

[0053] instead of being diode 61 when a switching device 9 turns off -- diode 31 -- flowing -- input AC-power-supply 1-> -- a current flows by the 1st root of choke coil 51 -> diode 31 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1. Vi-Ec is impressed to the 1st choke coil 51, and this current decreases linearly and serves as zero soon.

[0054] When input AC power supply 1 is reversed from the polarity of drawing 8 , diode 34 operates instead of the 2nd choke coil 52 and diode 61 instead of the 1st choke coil 51, and operates instead of diode 32 and diode 33 instead of diode 62 and diode 31, respectively.

[0055] If actuation of this 6th example is N= 1, it is equivalent to actuation of the 3rd example, and, ** Li and in the case of N< 1, equivalent to actuation of the 4th example.

(The 7th example) Drawing 9 shows the 7th example.

[0056] In drawing 9 , the 1st and 2nd structure and connecting location of choke coils 51 and 52 differ from the configuration of drawing 5 . The end of the 1st and 2nd choke coil 51 and 52 is connected to the both ends of the alternating current input power 1, respectively. The anode terminal of the 1st diode 61 and diode 31 is connected to the other end of the 1st choke coil 51, and the anode terminal of the 2nd diode 62 and diode 32 is connected to the other end of the 2nd choke coil 52. The cathode terminal of the 1st and 2nd diode is connected at the node of a primary winding 81 and a switching device 9. The cathode terminal of diodes 31 and 32 is connected at the node of a smoothing capacitor 4 and a primary winding 81.

[0057] Thus, actuation of the constituted switching power supply equipment is explained. first, the time of a switching device 9 being ON in the period of the polarity [AC power supply / 1 / input] of drawing 9 -- diodes 61 and 33 -- flowing -- input AC-power-supply 1-> -- 1st choke coil 51 -> diode 61 -> switching device 9 -> diode 33-> -- a current flows by the root of 2nd choke coil 52 -> input AC power supply 1. (One half) of the electrical potential differences of input AC power supply 1 is impressed to the 1st and 2nd choke coil 51 and 52, respectively, and this current increases linearly with the inclination proportional to the electrical potential difference of input AC power supply 1.

[0058] instead of being diode 61 when a switching device 9 turns off -- diode 31 -- flowing -- input AC-power-supply 1-> -- 1st choke coil 51 -> diode 31 -> smoothing capacitor 4 -> diode 33-> -- a current flows by the root of 2nd choke coil 52 -> input AC power supply 1. (One half) of the differences of the electrical potential difference of input AC power supply 1 and a smoothing capacitor 4 is impressed to the 1st and 2nd choke coil 51 and 52, respectively, and this current decreases linearly and serves as zero soon.

[0059] When input AC power supply 1 is reversed from the polarity of drawing 9 , diode 34 operates instead of diode 32 and diode 33 instead of diode 62 and diode 31 instead of diode 61, respectively.

[0060] By the repeat of this actuation, the current which flows to the 1st and 2nd choke coil 51 and 52 becomes the shape of a saw tooth wave which has the peak value proportional to the electrical potential difference of input AC power supply 1. The input current wave form where this was graduated with the filter capacitor 2 serves as the shape of a sine wave which carried out proportionally [abbreviation] at input alternating voltage.

[0061] Thus, actuation of the 7th example is the same as the configuration of drawing 1 , improve an input current wave form and improvement in a power-factor and reduction of a higher-harmonic-wave current component are attained, and since it flows without the current of the 1st and 2nd choke coil 51 and 52 minding a transformer 8 compared with the switching power supply equipment shown in drawing 31 , flow loss can be reduced.

[0062] (The 8th example) Drawing 10 shows the 8th example. In drawing 10 , differing from the configuration of drawing 9 is the point of having formed the tertiary winding 83 by which the end was connected to the transformer 8 at the end of a primary winding 81, and having connected the cathode terminal of the 1st and 2nd diode 61 and 62 to the

other end of a tertiary winding 83. The number of turns of N1 and a tertiary winding 83 are set to N3 for the number of turns of Ec and a primary winding 81, and the electrical potential difference of a smoothing capacitor 4 is made into N= (N3/N1).

[0063] Thus, actuation of the constituted switching power supply equipment is explained. First, in the period of the polarity [AC power supply / 1 / input] of drawing 10 , when a switching device 9 is ON, the electrical potential difference of N-Ec occurs in a tertiary winding 83. If the electrical potential difference Vi of input AC power supply 1 is larger than Ec (1-N), diodes 61 and 33 will flow. input AC-power-supply 1-> -- 1st choke coil 51 -> diode 61 -> tertiary-winding 83 -> primary-winding 81 -> switching device 9 -> diode 33 -> -- 2nd choke coil 52 -> input AC power supply 1 -- and input AC-power-supply 1-> -- 1st choke coil 51 -> diode 61 -> tertiary-winding 83 -> smoothing capacitor 4 -> diode 33 -> -- a current flows by the root of 2nd choke coil 52 -> input AC power supply 1. {Vi-(1-N) Ec} / 2 are impressed to the 1st and 2nd choke coil 51 and 52, respectively, and this current increases linearly with the inclination proportional to Vi-(1-N) Ec.

[0064] instead of being diode 61 when a switching device 9 turns off -- diode 31 -- flowing -- input AC-power-supply 1-> -- 1st choke coil 51 -> diode 31 -> smoothing capacitor 4 -> diode 33-> -- a current flows by the root of 2nd choke coil 52 -> input AC power supply 1. /2 are impressed to the 1st and 2nd choke coil 51 and 52, respectively (Vi-Ec), and this current decreases linearly and serves as zero soon.

[0065] When input AC power supply 1 is reversed from the polarity of drawing 10 , diode 34 operates instead of diode 32 and diode 33 instead of diode 62 and diode 31 instead of diode 61, respectively. Thus, if actuation of the 8th example is N= 1, it is equivalent to actuation of the 1st example, and, ** Li and in the case of N< 1, equivalent to actuation of the 2nd example.

[0066] (The 9th example) Drawing 11 shows the 9th example. In drawing 11 , differing from the configuration of drawing 1 is the point that the 1st and 2nd diode 61 and 62 is the 1st and 2nd capacitor 71 and 72, respectively.

[0067] Thus, actuation of the constituted switching power supply equipment is explained. First, in the period of the polarity [AC power supply / 1 / input] of drawing 11 , when a switching device 9 is ON, a current flows and increases by the root of input AC-power-supply 1 -> capacitor 71 -> switching device 9 -> choke coil 5 -> diode 33 -> input AC power supply 1. If charge of a capacitor 71 tends to progress, the potential of the node of a capacitor 71 and input AC power supply 1

tends to rise and it is going to become more than the potential of a smoothing capacitor 4, diode 31 will flow and a current will come to flow by the root of input AC-power-supply 1 -> diode 31 -> smoothing capacitor 4 -> choke coil 5 -> diode 33 -> input AC power supply 1.

[0068] The exciting current of a transformer 8 flows by the root of the primary-winding 81 -> capacitor 71 -> diode 31 -> primary winding 81, and makes the charge stored in the capacitor 71 discharge at the same time a current will flow by the root of input AC-power-supply 1 -> diode 31 -> smoothing capacitor 4 -> choke coil 5 -> diode 33 -> input AC power supply 1, if a switching device 9 turns off.

[0069] When input AC power supply 1 is reversed from the polarity of drawing 11 , diode 34 operates instead of diode 32 and diode 33 instead of diode 62 and diode 31 instead of diode 61, respectively.

[0070] Each part actuation wave by the repeat of such actuation is shown in drawing 12 . In drawing 12 , the current wave form where (a) flows to the output voltage wave of a full wave rectifier circuit 3, and (b) flows to a choke coil 5, and (c) are input current wave forms. The current which flows to a choke coil 5 turns into a continuation current which followed the electrical potential difference of input AC power supply 1. As for an input current wave form, this is graduated with a filter capacitor 2.

[0071] Thus, in the 9th example, an input current wave form is improved and improvement in a power-factor and reduction of a higher-harmonic current component are attained. Since the current of a choke coil 5 furthermore turns into a small continuation current of the amplitude compared with the 1st to 8th example when flowing without minding the transformer 8 shown in drawing 31 , flow loss can be reduced.

[0072] (The 10th example) Drawing 13 shows the 10th example. In drawing 13 , differing from the configuration of drawing 3 is the point that the 1st and 2nd diode 61 and 62 is the 1st and 2nd capacitor 71 and 72, respectively. The number of turns of N1 and a tertiary winding 83 are set to N3, and the number of turns of a primary winding 81 are made into N= (N3/N1).

[0073] Thus, in the 10th example, if it is N= 1, the actuation is equivalent to the 9th example, and, ** Li and in the case of N< 1, has the effectiveness of the 2nd example over the 1st example similarly to the 9th example.

[0074] (The 11th example) Drawing 14 shows the 11th example. In drawing 14 , differing from the configuration of drawing 5 is the point that the 1st and 2nd diode 61 and 62 is the 1st and 2nd capacitor 71 and 72, respectively.

[0075] Thus, actuation of the constituted switching power supply equipment is explained. first, the time of a switching device 9 being ON in the period of the polarity [AC power supply / 1 / input] of drawing 14 -- input AC-power-supply 1 -> capacitor 71-> -- a current flows and increases by the root of 1st choke coil 51 -> switching device 9 -> diode 33 -> input AC power supply 1. if charge of a capacitor 71 tends to progress, the potential of the node of a capacitor 71 and input AC power supply 1 tends to rise and it is going to become more than the potential of a smoothing capacitor 4 -- diode 31 -- flowing -- input AC-power-supply 1 -> diode 31-> -- a current comes to flow by the root of 2nd choke coil 52 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1.

[0076] if a switching device 9 turns off -- input AC-power-supply 1 -> diode 31-> -- the exciting current of a transformer 8 flows by the root of the primary-winding 81 -> capacitor 71 -> diode 31 -> primary winding 81, and makes the charge stored in the capacitor 71 discharge at the same time a current flows by the root of 2nd choke coil 52 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1

[0077] When input AC power supply 1 is reversed from the polarity of drawing 14 , diode 34 operates instead of diode 32 and diode 33 instead of diode 62 and diode 31 instead of diode 61, respectively.

[0078] Thus, in the 11th example, actuation of equivalence is considered as the 9th example and there is effectiveness of the 3rd example over the 1st example similarly to the 9th example.

(The 12th example) Drawing 15 shows the 12th example.

[0079] In drawing 15 , differing from the configuration of drawing 6 is the point that the 1st and 2nd diode 61 and 62 is the 1st and 2nd capacitor 71 and 72, respectively. The number of turns of N1 and a tertiary winding 83 are set to N3, and the number of turns of a primary winding 81 are made into N= (N3/N1).

[0080] Thus, in the 12th example, if it is N= 1, the actuation is equivalent to the 9th example, and, ** Li and in the case of N< 1, has the effectiveness of the 2nd example over the 1st example similarly to the 11th example.

[0081] (The 13th example) Drawing 16 shows the 13th example. In drawing 16 , differing from the configuration of drawing 7 is the point that the 1st and 2nd diode 61 and 62 is the 1st and 2nd capacitor 71 and 72, respectively.

[0082] Thus, actuation of the constituted switching power supply equipment is explained. first, the time of a switching device 9 being ON in the period of the polarity [AC power supply / 1 / input] of drawing

16 -- input AC-power-supply 1-> -- a current flows and increases by the 1st root of choke coil 51 -> capacitor 71 -> switching device 9 -> diode 33 -> input AC power supply 1. if charge of a capacitor 71 tends to progress, the potential of the node of a capacitor 71 and the 1st choke coil 51 tends to rise and it is going to become more than the potential of a smoothing capacitor 4 -- diode 31 -- flowing -- input AC-power-supply 1-> -- a current comes to flow by the 1st root of choke coil 51 -> diode 31 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1.

[0083] if a switching device 9 turns off -- input AC-power-supply 1-> -- the exciting current of a transformer 8 flows by the root of the primary-winding 81 -> capacitor 71 -> diode 31 -> primary winding 81, and makes the charge stored in the capacitor 71 discharge at the same time a current flows by the 1st root of choke coil 51 -> diode 31 -> smoothing capacitor 4 -> diode 33 -> input AC power supply 1

[0084] When input AC power supply 1 is reversed from the polarity of drawing 16 , diode 34 operates instead of the 2nd choke coil 52 and diode 61 instead of the 1st choke coil 51, and operates instead of diode 32 and diode 33 instead of diode 62 and diode 31, respectively.

[0085] Thus, in the 13th example, actuation of equivalence is considered as the 9th example and there is effectiveness of the 5th example over the 1st example similarly to the 9th example.

(The 14th example) Drawing 17 shows the 14th example.

[0086] In drawing 17 , differing from the configuration of drawing 8 is the point that the 1st and 2nd diode 61 and 62 is the 1st and 2nd capacitor 71 and 72, respectively. When the number of turns of N1 and a tertiary winding 83 are set to N3 and the number of turns of a primary winding 81 are made into N= (N3/N1), if it is N= 1, the actuation is equivalent to the 9th example, and, ** Li and in the case of N< 1, there is effectiveness of the 2nd example over the 1st example similarly to the 13th example.

[0087] (The 15th example) Drawing 18 shows the 15th example of this invention. In drawing 18 , differing from the configuration of drawing 9 is the point that the 1st and 2nd diode 61 and 62 is the 1st and 2nd capacitor 71 and 72, respectively.

[0088] Thus, actuation of the constituted switching power supply equipment is explained. first, the time of a switching device 9 being ON in the period of the polarity [AC power supply / 1 / input] of drawing 18 -- input AC-power-supply 1-> -- 1st choke coil 51 -> capacitor 71 -> switching device 9 -> diode 33-> -- a current flows and increases by the root of 2nd choke coil 52 -> input AC power supply 1. if charge of a

capacitor 71 tends to progress, the potential of the node of a capacitor 71 and the 1st choke coil 51 tends to rise and it is going to become more than the potential of a smoothing capacitor 4 -- diode 31 -- flowing -- input AC-power-supply 1-> -- 1st choke coil 51 -> diode 31 -> smoothing capacitor 4 -> diode 33-> -- a current comes to flow by the root of 2nd choke coil 52 -> input AC power supply 1.

[0089] if a switching device 9 turns off -- input AC-power-supply 1-> -- 1st choke coil 51 -> diode 31 -> smoothing capacitor 4 -> diode 33-> -- the exciting current of a transformer 8 flows by the root of the primary-winding 81 -> capacitor 71 -> diode 31 -> primary winding 81, and makes the charge stored in the capacitor 71 discharge at the same time a current flows by the root of 2nd choke coil 52 -> input AC power supply 1

[0090] When input AC power supply 1 is reversed from the polarity of drawing 18 , diode 34 operates instead of diode 32 and diode 33 instead of diode 62 and diode 31 instead of diode 61, respectively.

[0091] Thus, in the 15th example, the same actuation as the 9th example is carried out.

(The 16th example) Drawing 19 shows the 16th example.

[0092] In drawing 19 , differing from the configuration of drawing 10 is the point that the 1st and 2nd diode 61 and 62 is the 1st and 2nd capacitor 71 and 72, respectively. When the number of turns of N1 and a tertiary winding 83 are set to N3 and the number of turns of a primary winding 81 are made into N= (N3/N1), if it is N= 1, the actuation is equivalent to the 9th example, and, ** Li and in the case of N< 1, there is effectiveness of the 2nd example over the 1st example similarly to the 15th example.

[0093] in addition, in drawing 3 which shows the 2nd example, drawing 6 which shows the 4th example, drawing 8 which shows the 6th example, drawing 10 which shows the 8th example, drawing 13 which shows the 10th example, drawing 15 which shows the 12th example, drawing 17 which shows the 14th example, and drawing 19 which shows the 16th example Although the configuration of a tertiary winding 83 was carried out like drawing 20 (a), it cannot be overemphasized that a configuration like drawing 20 (b) is also possible.

[0094] (The 17th example) Drawing 21 shows the 17th example. Differing from the configuration of drawing 1 in drawing 21 is the point that the parallel circuit of a choke coil 53 is connected with the capacitor 73 between the cathode terminal of the 1st and 2nd diode 61 and 62, the primary winding 81, and the switching device 9.

[0095] Thus, the constituted switching power supply equipment carries

out the almost same actuation as the 9th example. First, in the period of the polarity [AC power supply / 1 / input] of drawing 21 , when a switching device 9 is ON, a current flows and increases by the root of input AC-power-supply 1 -> diode 61 -> capacitor 73 -> switching device 9 -> choke coil 5 -> diode 33 -> input AC power supply 1. The choke coil 53 by which parallel connection was carried out to the capacitor 73 at coincidence is excited. It flows in the direction in which the exciting current of a choke coil 53 discharges the charge stored in the capacitor 73 at the same time a current will flow by the root of input AC-power-supply 1 -> diode 31 -> smoothing capacitor 4 -> choke coil 5 -> diode 33 -> input AC power supply 1, if a switching device 9 turns off.

[0096] When input AC power supply 1 is reversed from the polarity of drawing 21 , diode 34 operates instead of diode 32 and diode 33 instead of diode 62 and diode 31 instead of diode 61, respectively.

[0097] That is, a capacitor 73 plays a role of the 1st and 2nd capacitor 71 and 72 in the 9th example, and when a switching device 9 is OFF, the choke coil 53 is playing a role of the primary winding 81 which discharges the charge of the 1st and 2nd capacitor 71 and 72.

[0098] Although the 17th example constituted the parallel circuit of a capacitor 73 and a choke coil 53 in the 1st and 2nd diode 61 and 62 and a serial by preparing in drawing 1 which shows the 1st example as shown in drawing 22 (a) As similarly shown in drawing 22 (b), the parallel circuit of a capacitor 74 and a choke coil 54 The switching power supply equipment which carries out the same actuation as the 17th example to the 1st diode 61 and a serial also by establishing the parallel circuit of a capacitor 75 and a choke coil 55 in the 2nd diode 62 and a serial is obtained.

[0099] It gives from the 2nd above-mentioned example also to the 8th example, and these configurations can still carry out same actuation.

(The 18th example) Drawing 23 and drawing 24 show the 18th example.

[0100] In drawing 23 , the function of a control circuit 40 differs from the configuration of drawing 1 , and it is a point which is controlling the switching frequency according to the electrical potential difference of a smoothing capacitor 4. The point currently controlled so that output direct current voltage stabilizes the on-off ratio of a switching device 9 is the same as the former and each above-mentioned example.

[0101] Thus, the constituted switching power supply equipment carries out the almost same actuation as the 1st example. The I/O voltage ratio of the DC to DC converter represented by the feedforward converter used for the example of this invention is expressed with the on-off ratio of a switching device 9. For this reason, the ON time amount and off time

amount of a switching device 9 hardly change that a switching frequency is immobilization depending on the output current. Even if the output current becomes small, the energy per switching 1 period inputted through a choke coil 5 or the 1st and 2nd choke coil 51 and 52 hardly changes. Therefore, when the output current becomes small, it goes up, as the electrical potential difference of a smoothing capacitor 4 indicates the property A of drawing 24 that I/O power can be balanced, and the thing of high pressure-proofing is needed for a switching device 9 or a smoothing capacitor 4.

[0102] On the other hand, in the 18th example, the electrical potential difference of a smoothing capacitor 4 is detected, and if this goes up, the control circuit 40 has the function in which a switching frequency also rises. If the output current becomes small and the electrical potential difference of a smoothing capacitor 4 rises, a switching frequency will also rise and the energy per switching 1 period inputted through a choke coil 5 or the 1st and 2nd choke coil 51 and 52 will decrease. Therefore, as shown in the property B of drawing 24 , the rise of the electrical potential difference of a smoothing capacitor 4 can be controlled.

[0103] Drawing 25 is the circuit diagram showing the example of a control circuit 40. The sign of each terminal made it correspond with the thing of the control circuit 40 of drawing 24 . The place enclosed with the broken line in drawing is the part which has the function explained by this example.

[0104] In drawing 25 , 400 is Control IC and uses a part number M51977 here. 401,402 is resistance, 403 is a capacitor, 401,402 determines the charge and discharge current of a capacitor 403, and the maximum ON time amount and the minimum off time amount, Li, and those sums serve as [the charge and discharge time] a switching period. Resistance and 406 are photo couplers, as for a shunt regulator and 407, detect output direct current voltage, and 404,405 returns to control IC 400. Control IC 400 determines that ON time amount will stabilize output direct current voltage, and outputs the driving pulse to a switching device 9. The time amount which deducted ON time amount from the switching period turns into off time amount. 408,409 will enlarge the charge and discharge current of a sink and a capacitor 403 for a current through diode 411, resistance 413, and diode 412 and resistance 414, if resistance and 410 input into a shunt regulator 410 the electrical potential difference of the smoothing capacitor 4 with which a shunt regulator and 411,412 are resistance and detected diode and 413,414 by resistance 408,409 and go up more than an electrical potential

difference predetermined in the electrical potential difference of a smoothing capacitor 4. That is, the switching frequency rises. Even if a switching frequency changes, control IC 400 decides on ON time amount within the maximum ON time amount which changed so that output direct current voltage may be stabilized.

[0105] Thus, in the 18th example, since the rise of the electrical potential difference of a smoothing capacitor 4 can be controlled, the thing of low pressure-proofing can be used for a switching device 9 or a smoothing capacitor 4.

[0106] In addition, although resistance division detected the electrical potential difference of a smoothing capacitor 4 in the 18th example, the thing for which the electrical potential difference equivalent to the electrical potential difference of a smoothing capacitor 4 may be detected, such as detecting the coil electrical potential difference of the transformer 8 generated when a switching device 9 is ON, cannot be overemphasized.

[0107] Moreover, although the control circuit 40 shown in this example is applied to the 1st example, it cannot be overemphasized that it is applicable to any example of the 2nd to 17th example.

[0108] (The 19th example) Drawing 26 and drawing 27 show the 19th example. Differing from the configuration of drawing 11 in drawing 26 is the point of having the engine performance as shown in drawing 27 to which the inductance value of a choke coil 5 becomes small, when the flowing current becomes large.

[0109] Thus, the constituted switching power supply equipment carries out the almost same actuation as the 9th example. However, when the output current becomes small in the 9th example, it is as the 18th example having described that the electrical potential difference of a smoothing capacitor 4 rises. In the case of the 9th example, when the switching device 9 turns on, the current which flows a choke coil 5 is the resonance current of a choke coil 5 and the 1st and 2nd capacitor 71 and 72, and an increment is not linearly carried out like the 1st example. Therefore, when the output current is large, even if the inductance value of a choke coil 5 is small, it seldom influences actuation of switching power supply equipment. On the other hand, when the output current is small, also in order to control the rise of the electrical potential difference of a smoothing capacitor 4, the larger one of the inductance value of a choke coil 5 is desirable.

[0110] On the other hand, in the 19th example, since it has the engine performance to which an inductance value becomes small if a current becomes [a choke coil 5] large, when the output current is large, the

same actuation as the 9th example is carried out, and when the output current is small, the rise of the electrical potential difference of a smoothing capacitor 4 is controlled rather than the 9th example. As for the rising characteristics of the electrical potential difference of the smoothing capacitor 4 of the 9th example, and a property B, the property A of drawing 28 shows the rising characteristics of the electrical potential difference of the smoothing capacitor 4 of the 19th example.

[0111] What is necessary is not to care about magnetic saturation, but to be few in the number of turns of a coil, and just to make the gap of a core small as a choke coil 5 which has such engine performance. That is, a choke coil 5 can be miniaturized.

[0112] In addition, if the 19th example and 18th example are used together, the change width of face of a switching frequency becomes small, and a more effective thing cannot be overemphasized. Moreover, although the choke coil 5 shown in this example is applied to the 9th example, it cannot be overemphasized that it is applicable to any [the 10th - / 17th] example. What is necessary is just to make it have the engine performance shown in the 1st and 2nd choke coil 51 and 52 by this example, when the choke coil 5 has composition of the 1st and 2nd choke coil 51 and 52.

[0113] In addition, in drawing 31 which shows the example of point invention, the series circuit of diode 10 and the fourth coil 84 is established in the both ends of a smoothing capacitor 4, and it is made to perform magnetic reset of a transformer 4 efficiently. However, to the effectiveness of this invention, greatly, since it was not indispensable to explanation of this invention, the effect the existence of the series circuit of diode 10 and the fourth coil 84 affects actuation of this invention was omitted in each example.

[0114] Moreover, in each example, although the circuitry based on a feedforward converter has explained, the same effectiveness can be acquired on the basis of other DC to DC converters.

[0115]

[Effect of the Invention] Since it flows according to the configuration of claim 1, without the current of a choke coil minding a transformer, flow loss can be reduced. Therefore, while a power-factor is good and has input characteristics with little input current harmonic content, outstanding switching power supply equipment with high effectiveness is realizable.

[0116] Since it flows according to the configuration of claim 2, without the current of a choke coil minding a tertiary winding when a switching device is OFF, flow loss can be reduced. Moreover, compared with the

case of claim 1, pressure-proofing of diode can be reduced by considering as the turn ratio N< 1 of a primary winding and a tertiary winding.

[0117] According to the configuration of claim 3, since it flows without the current of the 1st and 2nd choke coil minding a transformer, flow loss can be reduced. Moreover, since a choke coil 5 is in a positive-electrode side compared with claim 1 arranged at the negative-electrode side of a full wave rectifier circuit, a switching device and a control circuit serve as stabilization potential by the RF to input AC power supply, and it lifting-comes to be hard of malfunction.

[0118] According to the configuration of claim 4, if it is N= 1, it is equivalent to claim 1 and, ** Li and in the case of N< 1, equivalent to actuation of the 2nd example. Since it flows according to the configuration of claim 5, without the current of the 1st and 2nd choke coil minding a transformer, flow loss can be reduced. Moreover, since a choke coil is in a positive-electrode side compared with the configuration of claim 1 arranged at the negative-electrode side of a full wave rectifier circuit, a switching device and a control circuit serve as stabilization potential by the RF to input AC power supply, and it lifting-comes to be hard of malfunction.

[0119] According to the configuration of claim 6, if it is N= 1, it is equivalent to claim 3 and, ** Li and in the case of N< 1, equivalent to claim 4. Since it flows according to the configuration of claim 7, without being the same as that of claim 1, improving an input current wave form, attaining improvement in a power-factor, and reduction of a higher-harmonic-wave current component, and the current of the 1st and 2nd choke coil minding a transformer, flow loss can be reduced.

[0120] According to the configuration of claim 8, if it is N= 1, it is equivalent to claim 1 and, ** Li and in the case of N< 1, is claim 2 equivalence. According to the configuration of claim 9, an input current wave form is improved and improvement in a power-factor and reduction of a higher-harmonic current component are attained. Since the current of a choke coil furthermore turns into a small continuation current of the amplitude compared with each above-mentioned claim when flowing without minding a transformer, flow loss can be reduced.

[0121] According to the configuration of claim 10, if it is N= 1, the actuation is equivalent to claim 9, and, ** Li and in the case of N< 1, pressure-proofing of diode can be reduced compared with the case of claim 9.

[0122] According to the configuration of claim 11, it is equivalent to claim 9, since a choke coil is moreover in the positive-electrode side

of a full wave rectifier circuit, a switching device and a control circuit serve as stabilization potential by the RF to input AC power supply, and it lifting-comes to be hard of malfunction.

[0123] According to the configuration of claim 12, if it is N= 1, the actuation is equivalent to claim 9, and, ** Li and in the case of N< 1, pressure-proofing of diode can be reduced compared with the case of claim 11.

[0124] According to the configuration of claim 13, it is equivalent to claim 9, since a choke coil is moreover in a positive-electrode side compared with the configuration of claim 9 arranged at the negative-electrode side of a full wave rectifier circuit, a switching device and a control circuit serve as stabilization potential by the RF to input AC power supply, and it lifting-comes to be hard of malfunction.

[0125] According to the configuration of claim 14, if it is N= 1, the actuation is equivalent to claim 9, and, ** Li and in the case of N< 1, pressure-proofing of diode can be reduced compared with the case of claim 13.

[0126] According to the configuration of claim 15, the same actuation as claim 9 is carried out. According to the configuration of claim 16, it is equivalent to claim 9 and, ** Li and in the case of N< 1, pressure-proofing of diode can be reduced compared with the case of claim 15.

[0127] According to the configuration of claim 17, in either of claim 1 to claims 8, a property is improvable by infixing the parallel circuit of the 3rd choke coil and a capacitor in the 1st and 2nd diode and a serial.

[0128] According to the configuration of claim 18, the output current becomes small, and if the electrical potential difference of a smoothing capacitor 4 rises, a control circuit raises a switching frequency, and the energy per switching 1 period inputted through a choke coil or the 1st and 2nd choke coil can decrease, can control the rise of the electrical potential difference of a smoothing capacitor, and can use the thing of low pressure-proofing for a switching device or a smoothing capacitor.

[0129] Since it has the engine performance to which the inductance value of a choke coil becomes small if the current which flows in either of claim 1 to claims 18 according to the configuration of claim 19 becomes large, the rise of the electrical potential difference of a smoothing capacitor is controlled.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram of the 1st example
[Drawing 2] The input wave form chart of this example
[Drawing 3] The block diagram of the 2nd example
[Drawing 4] The input wave form chart of this example
[Drawing 5] The block diagram of the 3rd example
[Drawing 6] The block diagram of the 4th example
[Drawing 7] The block diagram of the 5th example
[Drawing 8] The block diagram of the 6th example
[Drawing 9] The block diagram of the 7th example
[Drawing 10] The block diagram of the 8th example
[Drawing 11] The block diagram of the 9th example
[Drawing 12] The input wave form chart of this example
[Drawing 13] The block diagram of the 10th example
[Drawing 14] The block diagram of the 11th example
[Drawing 15] The block diagram of the 12th example
[Drawing 16] The block diagram of the 13th example
[Drawing 17] The block diagram of the 14th example
[Drawing 18] The block diagram of the 15th example
[Drawing 19] The block diagram of the 16th example
[Drawing 20] The important section block diagram in the 2nd, 4, 6, 8, 10, 12, 14, and 16 example
[Drawing 21] The block diagram of the 17th example
[Drawing 22] The important section block diagram of this example
[Drawing 23] The block diagram of the 18th example
[Drawing 24] The important section property Fig. of this example
[Drawing 25] The important section circuit diagram of this example
[Drawing 26] The block diagram of the 19th example
[Drawing 27] The property Fig. of the choke coil of this example

[Drawing 28] The important section property Fig. of this example
[Drawing 29] The circuitry Fig. of conventional switching power supply equipment
[Drawing 30] The important section property Fig. of the conventional example
[Drawing 31] The circuitry Fig. of the switching power supply equipment explaining Object of the Invention
[Drawing 32] The important section property Fig. of the example of
******
[Description of Notations]
1 Input AC Power Supply
3 Full Wave Rectifier Circuit
31 3rd Diode
32 4th Diode
33 5th Diode
34 6th Diode
4 Smoothing Capacitor
5 Choke Coil
51 1st Choke Coil
52 2nd Choke Coil
53 3rd Choke Coil
61 1st Diode
62 2nd Diode
71 1st Capacitor
72 2nd Capacitor
73 3rd Capacitor
8 Transformer
81 Primary Winding of Transformer
82 Secondary Winding of Transformer
83 Tertiary Winding of Transformer
9 Switching Device
20 Rectification Smoothing Circuit
25 Load
40 Control Circuit

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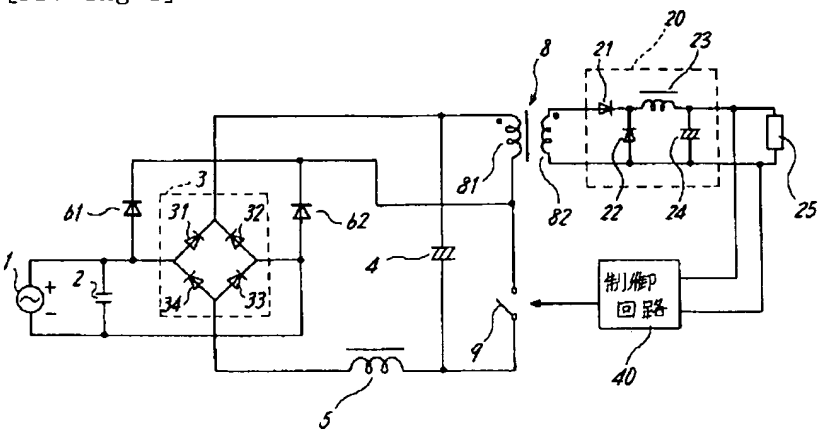
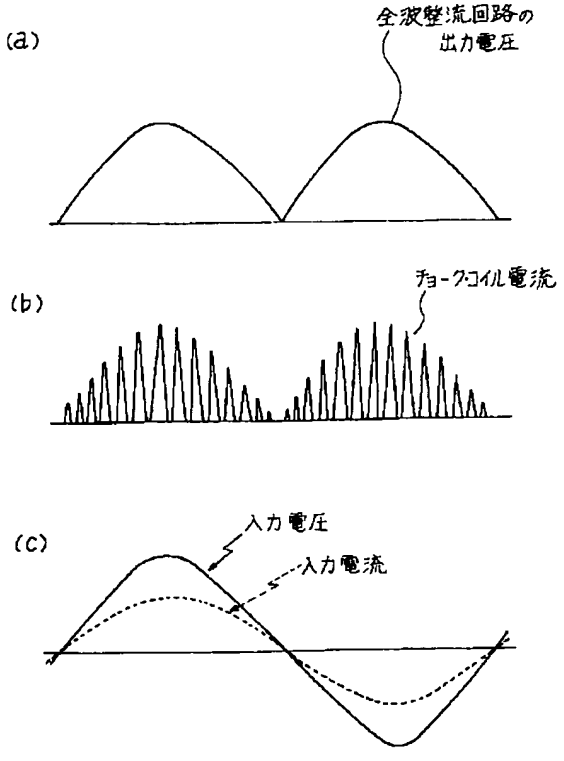
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

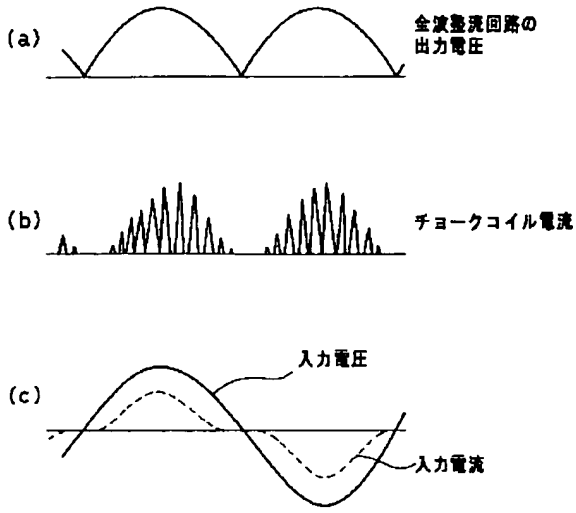
[Drawing 1]



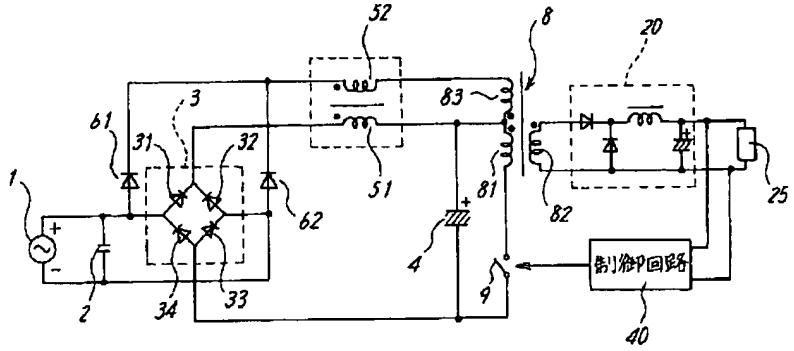
[Drawing 2]



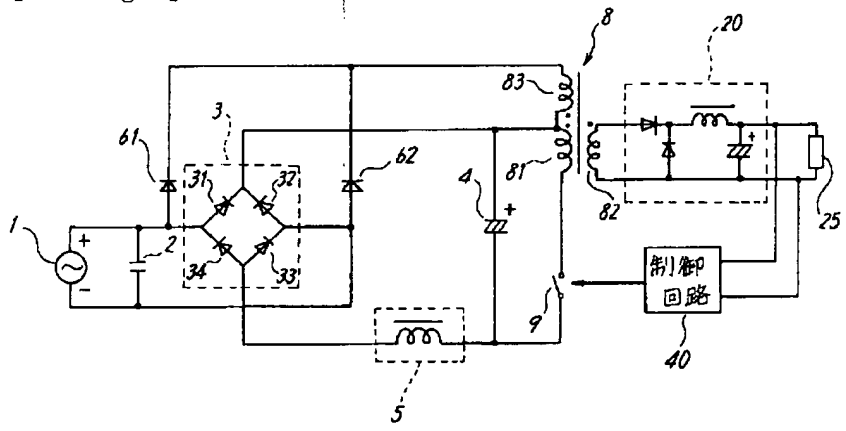
[Drawing 4]



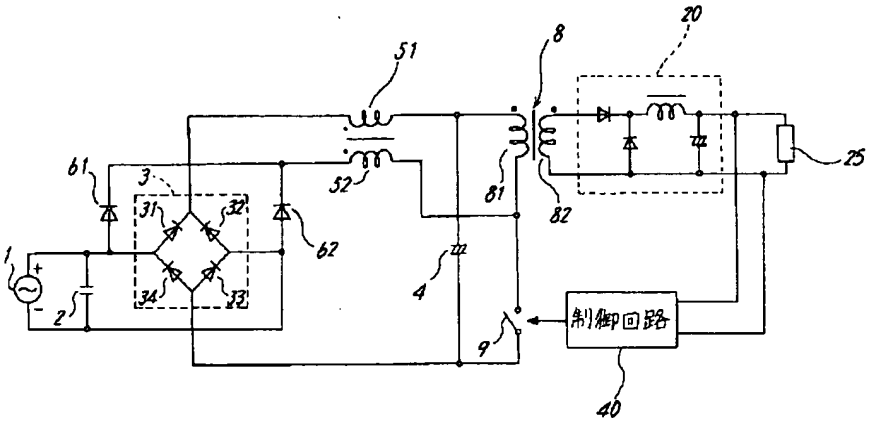
[Drawing 6]



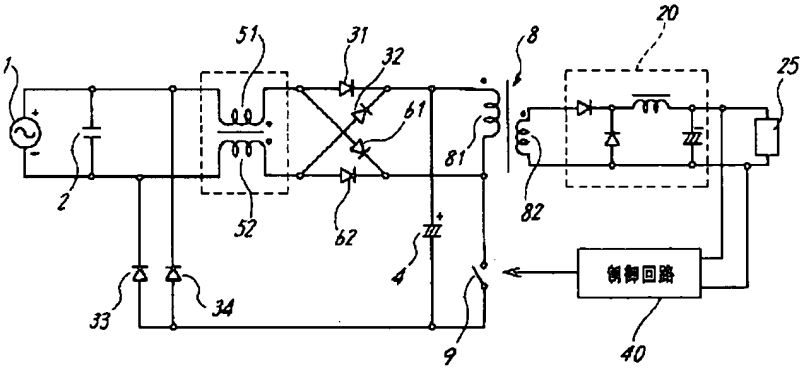
[Drawing 3]



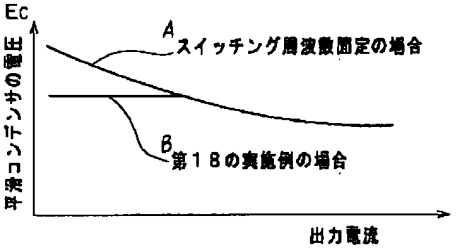
[Drawing 5]



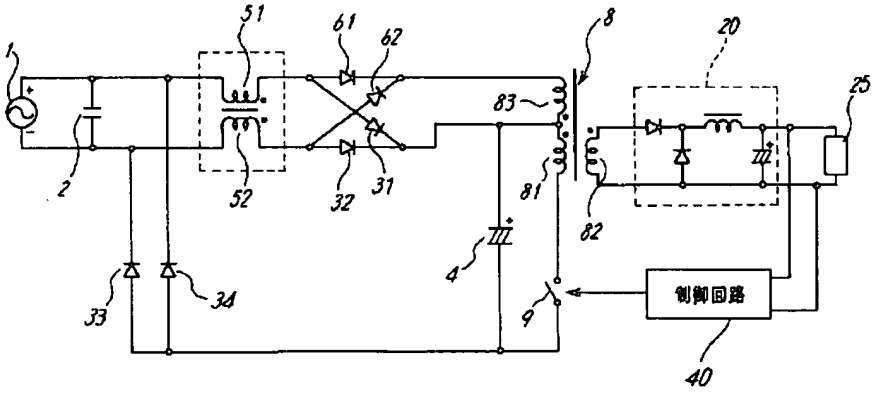
[Drawing 7]



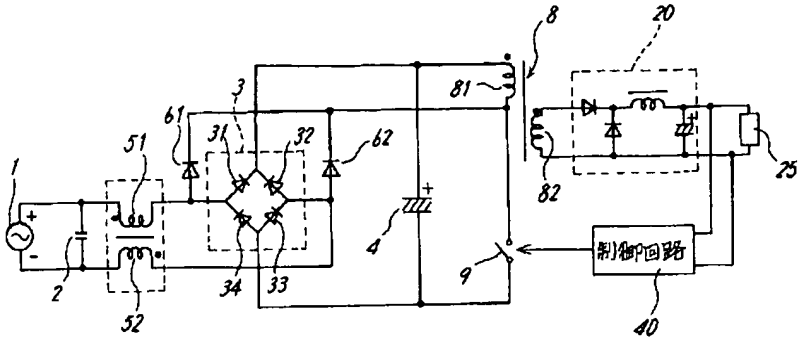
[Drawing 24]



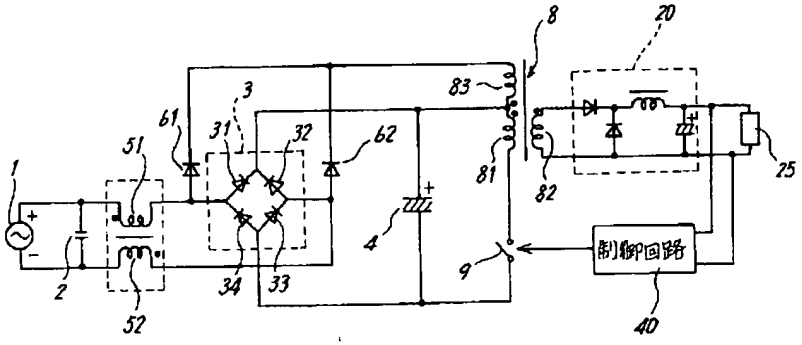
[Drawing 8]



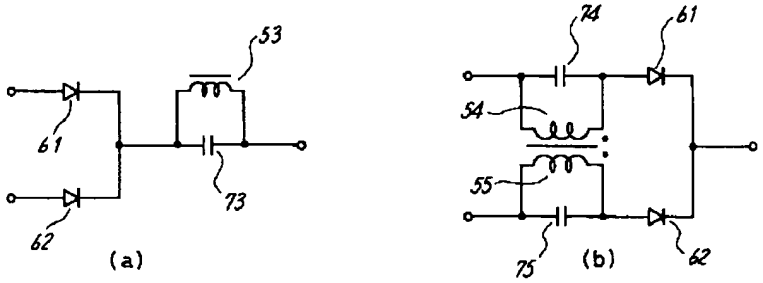
[Drawing 9]



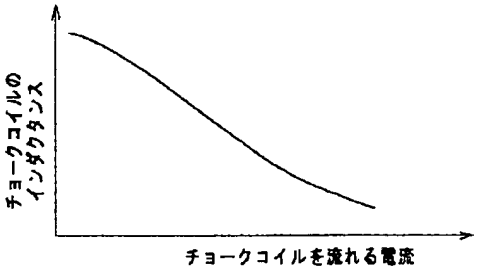
[Drawing 10]



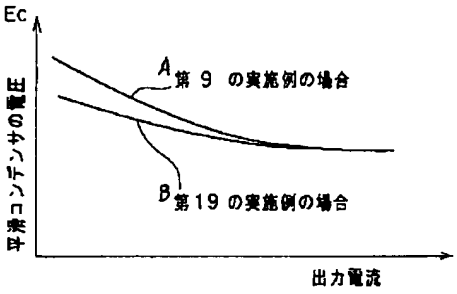
[Drawing 22]



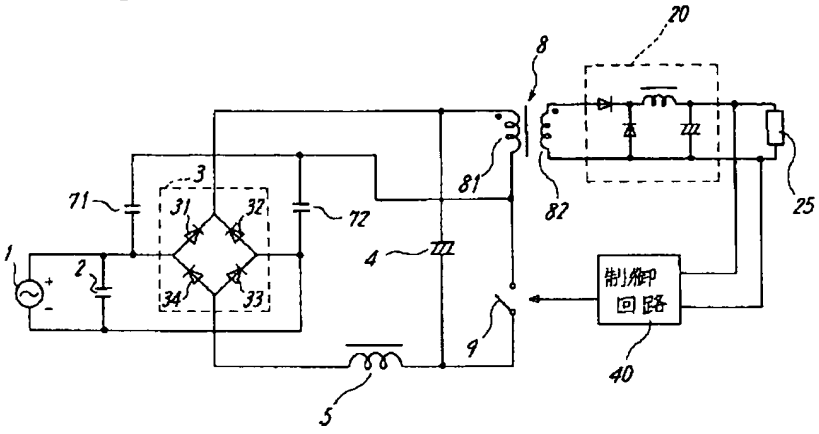
[Drawing 27]



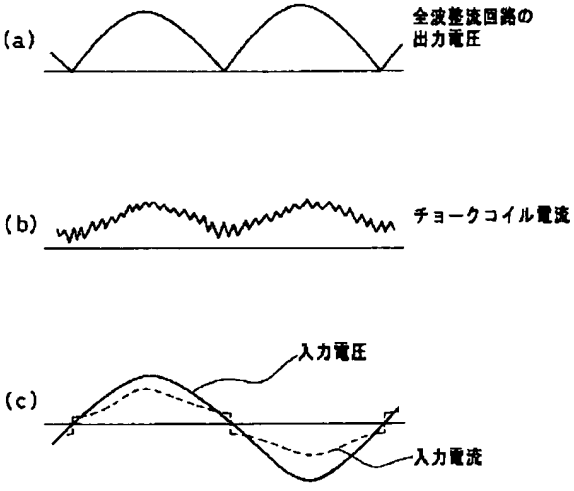
[Drawing 28]



[Drawing 11]



[Drawing 12]



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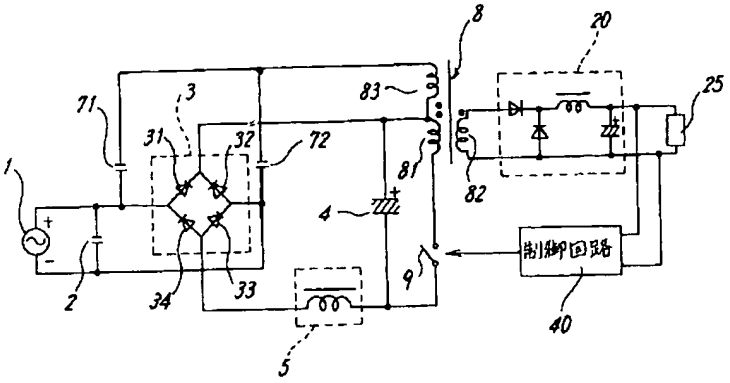
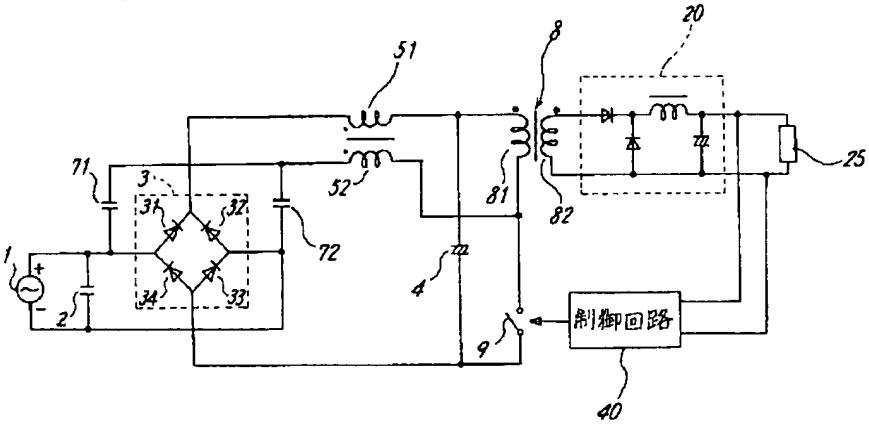
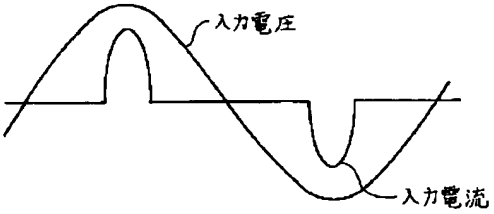


[Drawing 14]



[Drawing 30]



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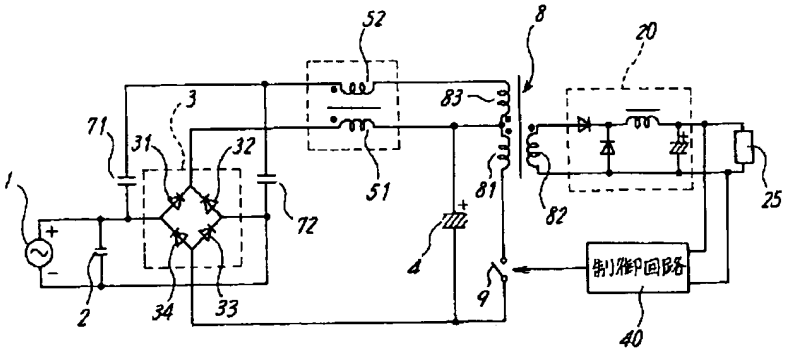
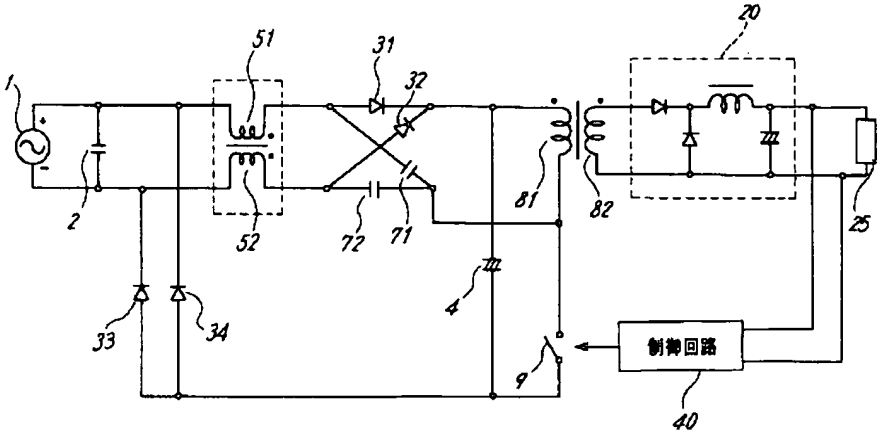
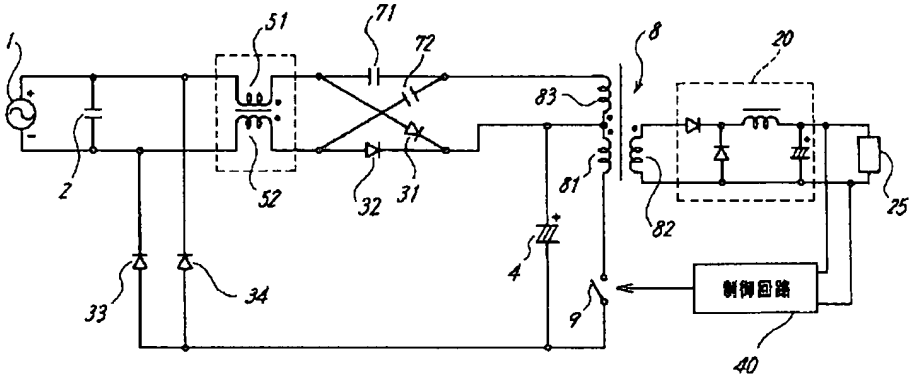


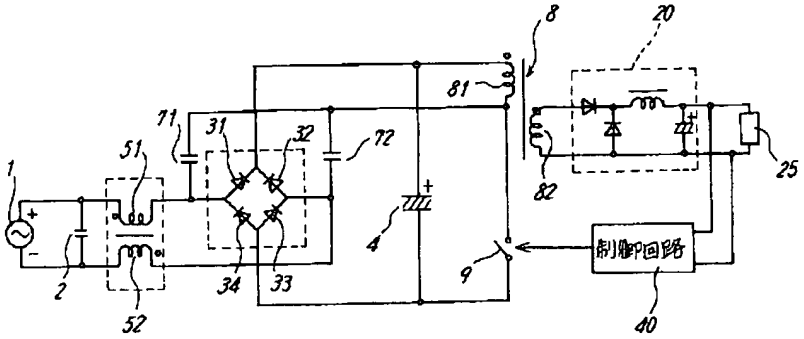
[Drawing 16]



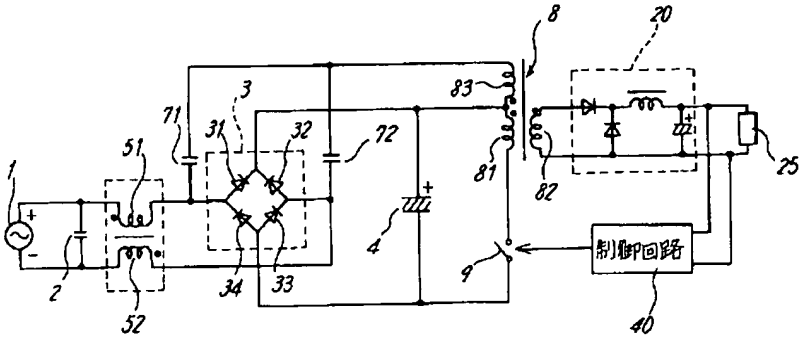
[Drawing 17]



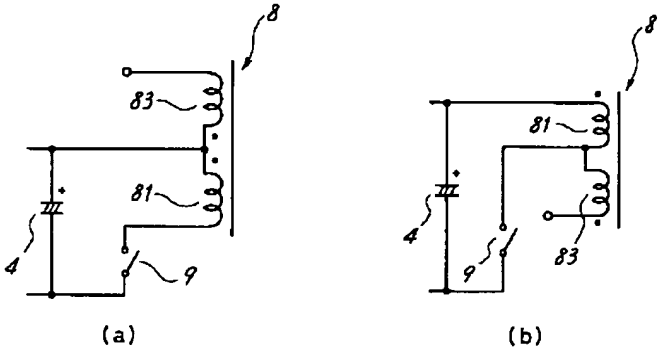
[Drawing 18]



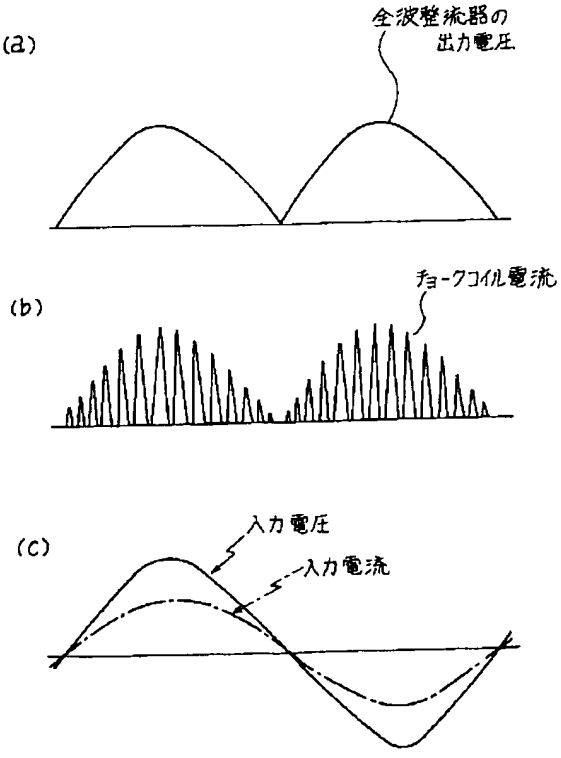
[Drawing 19]



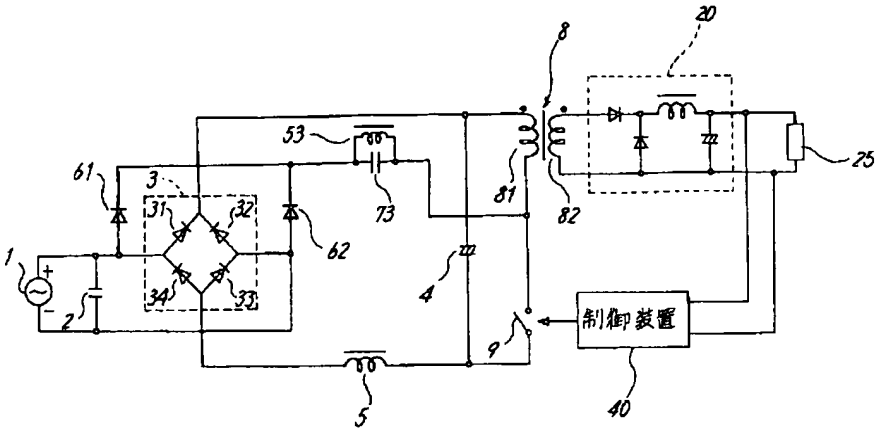
[Drawing 20]



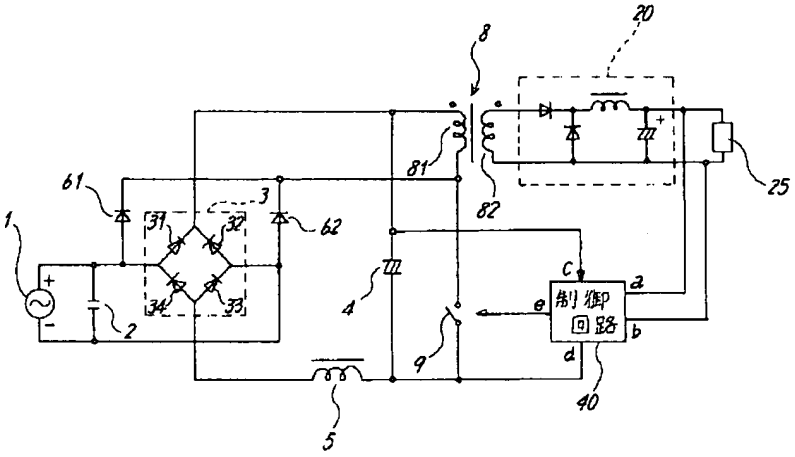
[Drawing 32]



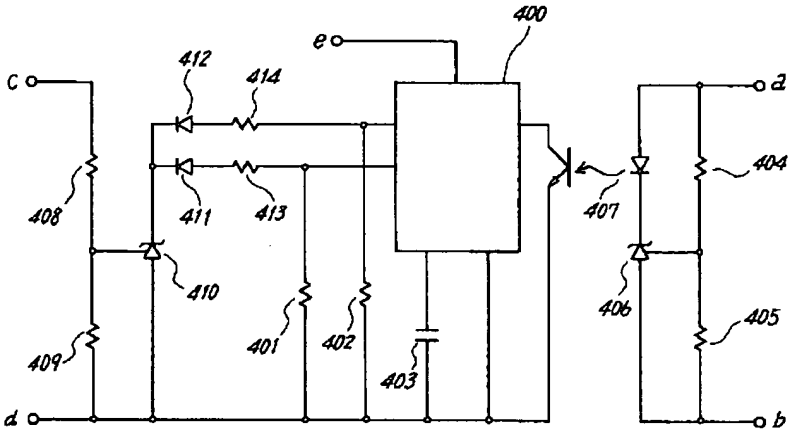
[Drawing 21]



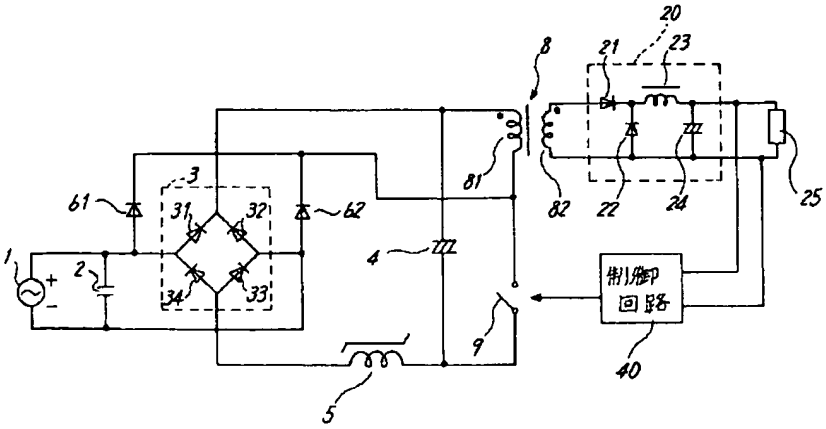
[Drawing 23]



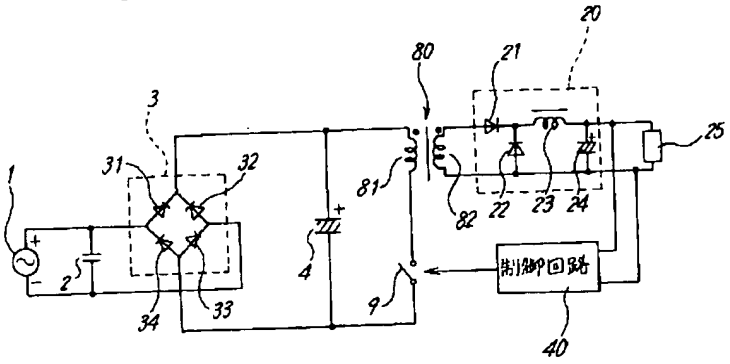
[Drawing 25]



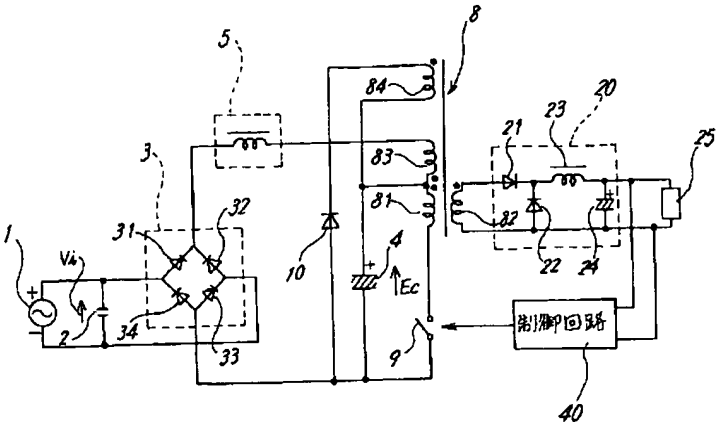
[Drawing 26]



[Drawing 29]



[Drawing 31]



[Translation done.]